



IMPERIAL INSTITUTE  
OF  
AGRICULTURAL RESEARCH, PUSA.







# **BULLETIN OF THE IMPERIAL INSTITUTE**

**A RECORD OF PROGRESS RELATING TO  
AGRICULTURAL, MINERAL AND OTHER  
INDUSTRIES, WITH SPECIAL REFERENCE TO  
THE UTILISATION OF THE RAW MATERIALS  
OF THE DOMINIONS, COLONIES AND INDIA**



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# BULLETIN OF THE IMPERIAL INSTITUTE

VOL. XXVI. 1928

## CONTENTS

### THE IMPERIAL INSTITUTE

	PAGE
GENERAL INFORMATION . . . . .	1
TRUSTEES AND BOARD OF GOVERNORS . . . . .	v
ADVISORY COUNCILS. . . . .	vii
STAFF . . . . .	ix

### REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

MANILA HEMP FROM ST. VINCENT . . . . .	1
BRITISH GUIANA WOODS FOR PAPER-MAKING—II . . . . .	4
CINCHONA BARK FROM UGANDA . . . . .	17
TOBACCO INDUSTRY OF MAURITIUS . . . . .	135
WOOL AND MOHAIR FROM IRAQ . . . . .	140
THE TOXIC PROPERTIES OF WEST AFRICAN RATSbane . . . . .	143
FULLER'S EARTH FROM NEW ZEALAND . . . . .	148
TIMBERS FROM THE GOLD COAST—II . . . . .	275
TOBACCO FROM NEW ZEALAND . . . . .	288
TOBACCO FROM UGANDA . . . . .	291
CAMPBOR LEAVES AND TWIGS FROM ST. LUCIA—II . . . . .	294

# CONTENTS

## REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE—*continued.*

	PAGE
PASPALUM CONJUGATUM GRASS FROM BRITISH HONDURAS . . . . .	296
SEAWEED FROM SEYCHELLES. . . . .	297
OIL SEEDS FROM BRITISH GUIANA . . . . .	411
A NEW OIL SEED FROM BRAZIL . . . . .	416
COFFEE FROM MAURITIUS, SIERRA LEONE AND SUDAN	418
DRIED LITCHIS FROM MAURITIUS. . . . .	423

## ARTICLES

TANNING MATERIALS OF THE BRITISH EMPIRE. PARTS III AND IV . . . . .	22, 311
THE SECOND (TRIENNIAL) MINING AND METALLURGI- CAL CONGRESS. WITH SOME ACCOUNT OF THE MINING AND POWER DEVELOPMENTS IN THE PRO- VINCES OF ONTARIO AND QUEBEC. BY SIR RICHARD REDMAYNE, K.C.B., M.I.C.E., F.G.S. (with Map and Diagrams) . . . . .	39
NOTES ON COAL MINING IN CANADA BY D. H. CURRER BRIGGS, J.P., M.A. (Oxon), M.I.M.E., A.M.I.C.E. . . . .	60
THE MINING INDUSTRY IN NOVA SCOTIA. BY COL. THE HON. G. S. HARRINGTON . . . . .	63
PRESENT STATUS AND FUTURE POSSIBILITIES OF THE MINING INDUSTRY IN BRITISH COLUMBIA. BY VICTOR DOLMAGE . . . . .	69
THE LIGNITES AND BROWN COALS OF THE BRITISH EMPIRE, AND THE USES TO WHICH THEY MAY BE PUT. BY SIR RICHARD REDMAYNE, K.C.B. . . . .	151
THE PUBLIC EXHIBITION GALLERIES OF THE IMPERIAL INSTITUTE (with 4 illustrations) . . . . .	300

## NOTES

FRUIT CULTIVATION IN SIERRA LEONE . . . . .	74
THE CITRUS INDUSTRY OF BRITISH HONDURAS . . . . .	75
WOOL PRODUCTION IN PERU. . . . .	76
THE NIPA PALM AS A SOURCE OF ALCOHOL IN MALAYA	161
BEEETLES INJURIOUS TO TIMBER . . . . .	164
BRITISH EMPIRE VEGETATION ABSTRACTS. . . . .	165

## CONTENTS

### NOTES—continued.

PAGE

MECHANICAL ANALYSIS OF HEAVY FERRUGINOUS SOILS . . . . .	166
THE POISONOUS PROPERTIES OF "KILIGI" TUBER FROM TANGANYIKA . . . . .	322
MADAGASCAR CLOVE INDUSTRY . . . . .	323
THE PREPARATION AND PACKING OF ORANGES FOR TRANSPORT . . . . .	326
SAND-DRIFT PLANTING IN CYPRUS . . . . .	327
EMPIRE-GROWN SISAL . . . . .	426
TOBACCO FROM UGANDA . . . . .	426
ENGLISH-GROWN PYRETHRUM AS AN INSECTICIDE . . . . .	428
FRENCH COLONIAL TIMBERS . . . . .	431

### RECENT RESEARCH ON EMPIRE PRODUCTS

CEYLON . . . . .	78
GAMBIA . . . . .	81
PALESTINE . . . . .	83
AGRICULTURE . . . . .	168, 331, 432
FORESTRY . . . . .	220
MISCELLANEOUS VEGETABLE PRODUCTS . . . . .	222
MISCELLANEOUS ANIMAL PRODUCTS . . . . .	223
MINERAL RESOURCES . . . . .	223, 476

### ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY

FOODSTUFFS AND FODDERS . . . . .	85, 354
OILS AND OIL-SEEDS. . . . .	88, 357, 487
ESSENTIAL OILS. . . . .	92, 364
FIBRES (INCLUDING COTTON) . . . . .	93, 367, 491
TOBACCO . . . . .	96
RESINS . . . . .	97, 372, 493
TANNING MATERIALS . . . . .	99, 374
FORESTRY AND TIMBERS. . . . .	102, 377, 494
MISCELLANEOUS . . . . .	104

## CONTENTS

	PAGE
BIBLIOGRAPHY (PLANT AND ANIMAL PRODUCTS) . . . . .	105, 242, 382, 497
NOTICES OF RECENT LITERATURE .	120, 256, 398, 516
BOOKS RECEIVED FOR NOTICE . .	133, 273, 407, 546
INDEX . . . . .	547

# LIST OF ILLUSTRATIONS

## THE SECOND (TRIENNIAL) MINING AND METALLURGICAL CONGRESS

FIG.	PAGE
1. "FLOW SHEET" OF TREATMENT AT NICKEL REFINERY . . .	48
2. AIR-COMPRESSING PLANT AT NORTHERN ONTARIO LIGHT AND POWER COMPANY . . . . .	52
3. SKETCH MAPS OF ITINERARIES . . . . .	<i>facing page 60</i>

## PUBLIC EXHIBITION GALLERIES OF THE IMPERIAL INSTITUTE

PLATE	FACING PAGE
I. THE EAST AFRICAN COURT . . . . .	300
II. A SHOW-CASE IN THE EAST AFRICAN COURT . . . . .	301
III. DIORAMA OF A MANGANESE MINE, GOLD COAST . . . . .	302
IV. DIORAMA OF THE BATHING AND BURNING GHATS, BENARES . . . . .	303





# REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

*Selected from the Reports made to the Dominion, Colonial  
and Indian Governments*

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## MANILA HEMP FROM ST. VINCENT

A SAMPLE of Manila hemp was received at the Imperial Institute in October 1927 from the Administrator of St. Vincent.

It was stated that the fibre had been obtained from *Musa textilis* plants which officers of the Agricultural Department had found growing in the Island in moderate numbers and that it had been prepared by the method practised by the natives in the Philippine Islands. It was desired to ascertain the quality and commercial value of the fibre.

The fibre had been graded into four portions, marked Grade A, Grade B, Grade C and Grade D respectively.

*Grade A.* This sample consisted of 10 lb. of clean, well-prepared, fairly fine, lustrous fibre, but contained some narrow ribbons in which the strands had not been separated. The product varied in colour from pale cream to pale brown and was of excellent length, ranging from 8 to 12 ft. and being mostly between 9 and 11 ft. The fibre was of good but rather irregular strength.

*Grade B.* This consisted of 21 lb. of fairly well-prepared fibre, but some of the material was in the form of thin ribbons, which, however, could be readily separated into the individual strands by rubbing or combing. The fibre was fairly lustrous and varied in colour from pale cream to pale brown, being on the whole rather darker than Grade A. It was of good length, ranging from 7 to 11 ft. and being mostly between 8 and 10 ft. The fibre

was in general of fair but very irregular strength, the darker-coloured portions being very weak.'

*Grade C.* This consisted of 36 lb. of fibre similar to Grade B in length and condition but rather finer. It was pale cream to pale brown and of fair but somewhat variable strength.

*Grade D.* This consisted of 47 lb. of material composed partly of clean narrow ribbons and partly of coarse fibre. It was fairly lustrous and mostly pale brown, a small quantity of paler fibre being present. The fibre varied in length from 8 to 12 ft., but was mostly between 9 and 11 ft. The ribbons were of good strength, but the separated fibre was not quite so strong.

A representative sample of Grade A was submitted to chemical examination in comparison with commercial Manila hemp of the F, G and L1 grades, and the results are given in the following table :

	Present sample.	Manila Hemp.		
	Grade A.	F Grade.	G Grade.	L1 Grade.
	Per cent.	Per cent.	Per cent.	Per cent.
Moisture . . . . .	9.7	10.7	10.6	8.9
Calculated on moisture-free material :				
Ash . . . . .	1.1	1.5	1.9	3.2
$\alpha$ -Hydrolysis, loss . . . . .	14.8	13.4	12.3	12.9
$\beta$ -Hydrolysis, loss . . . . .	21.6	20.2	19.2	19.3
Acid Purification, loss . . . . .	4.6	2.6	4.6	5.8
Water Washing, loss . . . . .	4.1	2.4	3.5	5.3
Cellulose . . . . .	74.8	76.9	74.5	74.8

These results show that in chemical composition and behaviour the Grade A fibre from St. Vincent compared quite satisfactorily with the three commercial grades of Manila hemp. The losses on  $\alpha$ - and  $\beta$ -hydrolysis, however, were very slightly higher, which is probably due to the fibre having been somewhat less thoroughly cleaned than that produced in the Philippines.

On the whole these samples of fibre had been fairly well cleaned and prepared. The quality of fibre in each grade, however, was somewhat variable, a portion in each case being of rather poor strength.

Samples of the four grades of fibre were submitted for an opinion as to their quality and commercial value

to Messrs. Wigglesworth and Co., Ltd., who reported as follows :

*Grade A.* Mostly fine fibre of good colour and good spinning quality with fine gloss. Similar to G grade Manila in quality but much longer, about one-third of it consisting of stained hemp which has evidently been produced from damaged leaves, being without strength. The remainder is all good strong hemp but rather badly stripped in places. The butt ends could be improved in scutching (stripping). Value £43 per ton compared with Manila G grade.

*Grade B.* Rather dull colour between G and J<sub>2</sub> grade Manila in quality. Containing about 50 per cent. of fibre practically without strength and evidently produced from damaged leaves as above. The remainder is of good strong spinning quality and of light colour. Same defect with butt ends. Value £42/£42 10s. per ton compared with Manila G and J<sub>2</sub>.

*Grade C.* All light colour with good gloss, about 50 per cent. well prepared and 50 per cent. badly stripped. Mostly nice light colour and best sample of the four, resembling J<sub>1</sub> Manila. Good strong fibre. Value £46/£47 per ton compared with J<sub>1</sub>-Manila grade.

*Grade D.* Fairly good colour but 60 per cent. very badly scutched (stripped) throughout from root to crop end. 40 per cent. much better prepared but not quite perfect. All good strong fibre if properly scutched and would be equal to J<sub>2</sub> Manila. Value £41/£42 per ton compared with Manila J<sub>2</sub>.

On the date of the valuations (November, 1927), Manila hemp was quoted at the following prices per ton : J<sub>1</sub>, £47 ; G, £43 ; J<sub>2</sub>, £42.

The following observations were added by Mr. Alfred Wigglesworth, Chairman of the Imperial Institute Advisory Committee on Vegetable Fibres :

The result is most encouraging and the samples are amongst the best I have seen produced outside the Philippine Islands ; they are considerably better than the lower grades from these Islands.

The weak fibre referred to in the report is probably

derived from the outside sheath which should have been discarded, or it may be due to the fibre having been left in a damp state, thus allowing physical deterioration to set in. This defect is well known in the Philippine Islands and it affects a considerable proportion of the crop there when the material is insufficiently stripped. It can be avoided by immediate and thorough stripping of the fibre, and thorough drying before it is baled.

I am of opinion that it would be distinctly worth while to propagate the plants for the production of the fibre on a commercial scale. It would obviously be necessary to know whether the rate of growth is sufficiently rapid, and can compare with that of the same plant in the Philippine Islands.

The results of this investigation indicate that the fibre obtainable from the *Musa textilis* plants growing in St. Vincent is of satisfactory quality and comparable with the Manila hemp produced in the Philippines. Such fibre would meet with a ready sale in the London market in competition with the latter, and the extended cultivation of the plants for fibre extraction might therefore be encouraged.

## BRITISH GUIANA WOODS FOR PAPER- MAKING.—II

A REPORT on the paper-making qualities of ten different timbers from British Guiana, as well as of certain other materials from that Colony, was published in this BULLETIN (1924, 22, 14). In 1926, samples of eleven commonly occurring timbers, which are likely to furnish considerable quantities of waste wood when the forests are eventually worked, were received for examination from the Forestry Department. The specimens were as follows :

Number.	Vernacular Name.	Number	Vernacular Name.
879	Greenheart	885	Trysil
880	Wallaba	886	Marishiballi
881	Kakaralli	887	Kautaballi
882	Mora	888	Morabukea
883	Yaruru	889	Moraballi
884	Itukibouroballi		

Such botanical material as was obtainable from the trees actually felled was also forwarded with a view to establishing the identity of the woods. These specimens were submitted to the Director of the Royal Botanic Gardens, Kew, who furnished the following provisional determinations; the material was purely vegetative and in the absence of flowers it was impossible to name the specimens more precisely.

879. *Ocotea Rodiei* (Schomb.) Mez. (?)—Compared with the specimens in the Kew Herbarium the leaves are much thinner and less glossy on the upper surface, and the finer venation is more evident on the upper surface. These differences, however, may be due to differences in the age of the leaves, those of No. 879, which are borne on a very slender vegetative branchlet, being apparently considerably younger than those on the flowering and fruiting specimens at Kew.

880. *Eperua falcata* Aubl.

881. *Eschweilera laevifolia* Miers(?). In Benth. et Hook. f. *Gen. Plant.* the genus *Eschweilera* is included in *Lecythis*.

882. *Dimorphandra Mora* Benth. et Hook. f. (?)—The leaflets are longer, rather differently shaped and thinner than those of the specimens in the Kew Herbarium, but these differences are such as might possibly be found between the leaves of a quickly growing vegetative shoot and those of a flowering shoot.

883. *Aspidosperma excelsum* Benth. (?)—The leaves are narrower with slenderer petioles than those of authenticated specimens in the Kew Herbarium, but the material seems to agree in other respects.

884. *Leguminosae*, genus indeterminable without flowers or fruits.

885. *Pentaclethra filamentosa* Benth.

886. Indeterminable.

887. *Licania venosa* Rusby. This species, which was described in 1920, was previously confused with *L. mollis* Benth.

888. *Leguminosae*, genus indeterminable without flowers or fruit, but probably not *Dimorphandra*, as had been suggested by the Forestry Department in a letter relating to the specimens.

889. *Leguminosae-Caesalpinias*, genus indeterminable without flowers or fruit, possibly *Pellogyne*.

In all cases the material received for the paper-making trials consisted of a log of wood with the bark on. The wood was examined chemically, the percentages of moisture, ash and cellulose being determined; and the dimensions of the ultimate fibres of which it was composed were measured. Paper-making trials were carried out in the laboratory by treating the wood (after being freed from bark and cut into chips) with caustic soda under conditions similar to those employed for the production of paper pulp on a commercial scale. Specimens of the paper produced in the course of the trials were forwarded with the report to British Guiana and samples are also available at the Imperial Institute for inspection by persons interested.

#### NO. 879. GREENHEART

The log in this case was 7 in. in diameter, and weighed 54 lb. The wood was very dense, hard, close-grained and of yellow colour. The bark was hard and woody, about  $\frac{1}{2}$  in. thick and easily detachable.

#### Results of Chemical Examination

	Per cent.
Moisture . . . . .	13.0
Ash . . . . .	0.48
Cellulose in material as received . . . . .	47.7
Cellulose expressed on the moisture-free wood . . . . .	54.8

#### Dimensions of Ultimate Fibres

	Length. mm.	Diameter. mm.
Maximum . . . . .	2.0	0.0254
Minimum . . . . .	0.8	0.0050
Average . . . . .	1.2	0.0152

#### Results of Paper-making Trials

Trial.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp.	
	Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Unbleached.	Bleached.
A	20	4	hrs. 5	° C. 160	8.6	Per cent. 42.0	Per cent. 41.0
B	20	4	6	160	9.4	41.0	38.0

Under the conditions of Trial A the pulp obtained was not sufficiently digested and could not be bleached ; it furnished a pale brown, soft, rather bulky paper of moderate strength. The conditions of Trial B were just sufficient to produce a well-digested homogeneous pulp which furnished a pale brown paper. It did not bleach readily and required about twice as much bleaching solution as is necessary for poplar pulp. After treatment it yielded a soft, rather bulky, cream-coloured paper of moderate strength.

The results of these experiments show that Greenheart gives a fairly good yield of pulp which is of rather poor quality.

#### NO. 880. WALLABA

This log was 6½ in. in diameter and weighed 46 lb. The wood was hard and reddish-brown, with a lighter-coloured sap-wood. Dark patches, due to resin ducts, occurred concentrically in the transverse section. The bark was hard and woody, about ¼ in. thick and easily detachable.

#### Results of Chemical Examination

	Per cent.
Moisture . . . . .	16·7
Ash . . . . .	0·58
Cellulose in material as received . . . . .	33·1
Cellulose expressed on the moisture-free wood . . . . .	39·7

#### Dimensions of Ultimate Fibres

	Length. mm.	Diameter. mm.
Maximum . . . . .	2·0	0·0279
Minimum . . . . .	0·6	0·0050
Average . . . . .	1·4	0·0150

#### Results of Paper-making Trials

Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp.	
Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Unbleached.	Bleached.
20	4	hrs. 5	° C. 160	10·0	Per cent. 35	Per cent. 32

Under the conditions of this trial a well-reduced pulp was obtained which felted well and furnished a soft greyish-brown paper of good strength and quality. The pulp bleached readily to a pale cream colour.



These results indicate that Wallaba gives a pulp of good quality and readily bleachable, but that the yield is rather lower than that from most timbers.

### No. 881. KAKARALLI

This log was 7 in. in diameter, and weighed 58 lb. The wood was hard, pale reddish-brown and close-grained. The bark was tough and fibrous, about  $\frac{1}{2}$  in. thick and easily detachable.

#### Results of Chemical Examination

	Per cent.
Moisture . . . . .	13.7
Ash . . . . .	1.8
Cellulose in material as received . . . . .	42.9
Cellulose expressed on the moisture-free wood. . . . .	49.6

#### Dimensions of Ultimate Fibres

	Length. mm.	Diameter. mm.
Maximum . . . . .	2.7	0.0280
Minimum . . . . .	1.0	0.0050
Average . . . . .	1.6	0.0177

#### Results of Paper-making Trials

Trial.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp.	
	Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Unbleached	Bleached.
A	20	4	hrs. 5	° C. 160	10.8	Per cent. 45	Per cent. 39
B	20	4	6	160	12.1	35	32

The conditions of the digestion in Trial A were adequate for the production of a well-reduced pulp. The pulp furnished a soft brown paper of moderate strength, but did not bleach readily; even when submitted to a strong bleaching solution the colour was only reduced to a pale yellowish-brown.

The pulp obtained in Trial B furnished paper of similar quality to that obtained in Trial A. The increased time of digestion caused a reduction in the yield of pulp, but the pulp, although still not readily bleachable, could be reduced to a cream colour.

It is thus evident that Kakaralli gives a fairly good yield of pulp which is of rather poor quality and not readily bleachable.

## No. 882. MORA

This log was  $8\frac{1}{2}$  in. in diameter, and weighed 79 lb. The heart-wood was pale reddish-brown and the sap-wood somewhat coarse-grained and rather paler. The bark was hard and woody, about  $\frac{1}{2}$  in. thick and easily detachable.

*Results of Chemical Examination*

	<i>Per cent.</i>
Moisture . . . . .	11.6
Ash . . . . .	0.5
Cellulose in material as received . . . . .	47.1
Cellulose expressed on the moisture-free wood. . . . .	53.3

*Dimensions of Ultimate Fibres*

	Length. mm.	Diameter. mm.
Maximum . . . . .	2.2	0.0279
Minimum . . . . .	0.7	0.0076
Average . . . . .	1.5	0.0173

*Results of Paper-making Trials*

Trial.	Caustic soda used.		Conditions of digestion		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp.	
	Parts per 100 parts of wood.	Parts per 100 parts of solution	Time	Temp		Unbleached	Bleached.
			hrs	° C		<i>Per cent.</i>	<i>Per cent.</i>
A	20	4	5	160	10.0	48	40
B	20	4	6	160	10.8	41	35

The conditions of Trial A were just sufficient to produce a well-reduced pulp which furnished a strong, pale brown paper. The pulp felted well but did not bleach readily, and the colour could only be reduced to cream.

The pulp obtained in Trial B was of similar character to that obtained in Trial A, but the increased time of digestion caused a reduction in the yield. The bleached pulp yielded a strong white paper of good quality.

These results show that Mora gives a fairly good yield of pulp which is of good quality and furnishes strong paper.

## No. 883. YARURU

This sample, which weighed 37 lb., consisted of a log, irregular in cross-section, with a maximum width of about 8 in. The wood was hard, close-grained, and varied in colour from pale yellow to pale pink. The bark was about  $\frac{1}{2}$  in. thick and not easily detachable.

*Results of Chemical Examination*

	<i>Per cent.</i>
Moisture . . . . .	9.6
Ash . . . . .	0.64
Cellulose in material as received . . . . .	47.1
Cellulose expressed on the moisture-free wood. . . . .	52.1

*Dimensions of Ultimate Fibres*

	<i>Length.</i> <i>mm.</i>	<i>Diameter.</i> <i>mm.</i>
Maximum . . . . .	2.2	0.0305
Minimum . . . . .	1.0	0.0102
Average . . . . .	1.5	0.0213

*Results of Paper-making Trials*

<i>Caustic soda used.</i>		<i>Conditions of digestion.</i>		<i>Parts of caustic soda consumed per 100 parts of wood.</i>	<i>Yield of dry pulp.</i>	
<i>Parts per 100 parts of wood.</i>	<i>Parts per 100 parts of solution.</i>	<i>Time.</i>	<i>Temp.</i>		<i>Unbleached.</i>	<i>Bleached.</i>
		<i>hrs.</i>	<i>° C.</i>		<i>Per cent.</i>	<i>Per cent.</i>
20	4	6	160	12.6	46.0	45.0

Under the conditions of this experiment a well-reduced pulp was obtained which furnished a weak, soft, rather dark-brown paper. The pulp was not easily bleached, the colour being only reducible to yellowish-brown.

These results indicate that Yaruru gives a good yield of pulp which, however, is of poor quality and cannot be satisfactorily bleached.

NO. 884. ITIKIBOUROBALLI

This was a roughly cylindrical log, 7 in. in diameter and weighing 50 lb. The wood was hard and rather close-grained; the sap-wood was of pale yellowish colour and the heart-wood was similar but of a lighter shade. The log had a dark brown core approximately 2 in. in diameter with a hole through the centre. The bark was tough and fibrous,  $\frac{1}{8}$  in. thick, and easily detachable.

*Results of Chemical Examination*

	<i>Per cent.</i>
Moisture . . . . .	12.7
Ash . . . . .	0.57
Cellulose in material as received . . . . .	52.0
Cellulose expressed on the moisture-free wood. . . . .	59.5

*Dimensions of Ultimate Fibres*

	<i>Length.</i> <i>mm.</i>	<i>Diameter.</i> <i>mm.</i>
Maximum . . . . .	1.5	0.0279
Minimum . . . . .	0.6	0.008
Average . . . . .	1.1	0.0185

*Results of Paper-making Trials*

Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp.	
Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Unbleached.	Bleached.
20	4	hrs. 5	° C. 160	9.4	Per cent. 42	Per cent. 36

The conditions employed in this trial were just sufficient to produce a well-digested pulp. The pulp furnished a soft, rather bulky, pale brown paper of moderate strength. It did not bleach readily and required a strong bleaching solution to reduce it to a cream colour.

The results of these experiments show that Itikibouroballi gives a fairly good yield of pulp which is of rather poor quality.

No. 885. TRYFIL

This log was 6 in. in diameter and weighed 36 lb. The wood was hard and fairly close-grained; the heart-wood was pale reddish-brown and the sap-wood slightly lighter. The bark was tough and fibrous, about  $\frac{1}{8}$  in. thick and easily detachable.

*Results of Chemical Examination*

	Per cent.
Moisture . . . . .	15.5
Ash . . . . .	0.4
Cellulose in material as received . . . . .	42.6
Cellulose expressed on the moisture-free wood . . . . .	50.4

*Dimensions of Ultimate Fibres*

	Length. mm.	Diameter. mm.
Maximum . . . . .	3.0	0.033
Minimum . . . . .	0.8	0.008
Average . . . . .	1.2	0.0178

*Results of Paper-making Trials*

Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp.	
Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Unbleached.	Bleached.
20	4	hrs. 5	° C. 160	8.6	Per cent. 37	Per cent. 35

Under the conditions of this trial a well-digested pulp was obtained which furnished a strong greyish-brown paper.

The pulp did not bleach readily and after treatment with strong bleaching solution furnished a pale cream-coloured paper.

These results show that Trysil gives a fairly satisfactory yield of pulp which is of good strength and quality but not readily bleachable.

#### No. 886. MARISHIBALLI

This log was 6 to 7 in. in diameter and weighed 50 lb. The wood was hard, close-grained and pale reddish-brown. The bark was hard and woody, about  $\frac{1}{4}$  in. thick and easily detachable.

##### *Results of Chemical Examination*

	<i>Per cent.</i>
Moisture . . . . .	16.2
Ash . . . . .	1.4
Cellulose in material as received . . . . .	52.3
Cellulose expressed on the moisture-free wood . . . . .	62.4

##### *Dimensions of Ultimate Fibres*

	Length. mm.	Diameter. mm.
Maximum . . . . .	2.2	0.0356
Minimum . . . . .	0.9	0.0076
Average . . . . .	1.5	0.0167

##### *Results of Paper-making Trials*

Trial.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood	Yield of dry pulp.	
	Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time	Temp.		Unbleached	Bleached.
A	20	4	hrs. 5	° C 160	10.8	<i>Per cent.</i> 44	<i>Per cent.</i> 37
B	20	4	6	160	11.1	40	37

The conditions of trial A did not produce a well-digested pulp, a fair proportion of undisintegrated material being still present. The pulp furnished a pale brown, rather soft, bulky paper of fair strength. The pulp did not bleach readily, but when treated with a strong bleaching solution was reduced to a yellowish-cream colour.

The increased time of digestion in trial B proved sufficient to yield a well-digested pulp free from undisintegrated material. The pulp furnished a rather soft, pale brown paper of fair strength. It did not bleach readily,

but when treated with a strong bleaching solution was reduced to a cream colour.

This Marishiballi wood gives a good yield of pulp which furnishes a paper of fair strength and quality but is not readily bleachable.

No. 887. KAUTABALLI

This log was  $5\frac{1}{2}$  in. in diameter and weighed  $46\frac{1}{2}$  lb. The wood was hard, close-grained and pale reddish-brown. The bark was tough and fibrous, about  $\frac{1}{2}$  in. thick and easily detachable.

*Results of Chemical Examination*

	Per cent.
Moisture . . . . .	10.7
Ash . . . . .	1.4
Cellulose in material as received . . . . .	55.3
Cellulose expressed on the moisture-free wood . . . . .	61.8

*Dimensions of Ultimate Fibres*

	Length. mm.	Diameter. mm.
Maximum . . . . .	2.3	0.0305
Minimum . . . . .	0.9	0.0102
Average . . . . .	1.8	0.0203

*Results of Paper-making Trials*

Trial.	Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood	Yield of dry pulp.	
	Parts per 100 parts of wood.	Parts per 100 parts of solution	Time	Temp		Unbleached	Bleached.
A	20	4	hrs	° C	10.6	Per cent.	Per cent.
B	20	4	5	160	11.4	48	44
			6	160		44	40

The conditions of trial A were not sufficiently severe to produce a well-digested pulp. The pulp obtained furnished a pale brown paper containing a fair proportion of undisintegrated material ; the paper was very soft, rather bulky, and of poor strength. On treatment with bleaching solution the pulp was reduced to a dark cream colour.

The increased time of digestion employed in trial B resulted in the production of a well-digested pulp which furnished a paper of similar colour and character to that obtained in trial A, but almost free from particles of undisintegrated material. The pulp did not bleach readily and when treated with a strong bleaching solution was

reduced to a cream colour. The paper obtained from this bleached pulp was weak and contained occasional small dark specks.

This Kautaballi wood gives a fairly good yield of pulp which furnishes a rather soft bulky paper and is not readily bleachable.

#### NO. 888. MORABUKEA

The log was roughly cylindrical,  $5\frac{1}{2}$  to 6 in. in diameter and weighed 45 lb. The wood was hard and close-grained ; the sap-wood was pale reddish-brown and the heart-wood slightly darker. The bark was woody and brittle, about  $\frac{1}{8}$  in. thick, and not easily detachable.

#### Results of Chemical Examination

	Per cent.
Moisture . . . . .	14.0
Ash . . . . .	0.4
Cellulose in material as received . . . . .	50.5
Cellulose expressed on the moisture-free wood . . . . .	58.8

#### Dimensions of Ultimate Fibres

	Length. mm.	Diameter. mm.
Maximum . . . . .	2.2	0.0279
Minimum . . . . .	0.8	0.0076
Average . . . . .	1.2	0.017

#### Results of Paper-making Trials

Caustic soda used.		Conditions of digestion.		Parts of caustic soda consumed per 100 parts of wood.	Yield of dry pulp.	
Parts per 100 parts of wood.	Parts per 100 parts of solution.	Time.	Temp.		Unbleached.	Bleached.
		hrs.	° C.		Per cent.	Per cent.
20	4	5	160	9.4	45	40

The conditions employed in this trial were sufficient to produce a fairly well-digested pulp, which furnished a pale brown paper of good strength but containing some undisintegrated material. The pulp bleached fairly readily and in the course of the process the incompletely reduced material was further disintegrated and a white paper of good strength was obtained which was almost free from specks.

This Morabukea wood gives a fairly good yield of pulp

which furnishes paper of good strength and can be fairly readily bleached.

No. 889. MORABALLI

This log was roughly cylindrical,  $6\frac{1}{2}$  in. in diameter, and weighed 70 lb. The wood was hard and close-grained ; the sap-wood was pale reddish-brown, and the heart-wood somewhat darker. The bark was tough and woody,  $\frac{1}{2}$  in. thick and easily detachable.

*Results of Chemical Examination*

	<i>Per cent.</i>
Moisture . . . . .	12.6
Ash . . . . .	0.8
Cellulose in material as received . . . . .	48.45
Cellulose expressed on the moisture-free wood . . . . .	55.4

	Length.	Diameter.
	<i>mm</i>	<i>mm</i>
Maximum . . . . .	2.1	0.0305
Minimum . . . . .	0.7	0.0127
Average . . . . .	1.1	0.0216

*Results of Paper-making Trials*

Trial	Caustic soda used		Conditions of digestion		Parts of caustic soda consumed per 100 parts of wood	Yield of dry pulp.	
	Parts per 100 parts of wood.	Parts per 100 parts of solution	Time	Temp.		Unbleached	Bleached.
			<i>hrs</i>	<i>° C</i>		<i>Per cent.</i>	<i>Per cent.</i>
A	20	4	5	160	12.6	42	35
B	20	4	6	160	12.7	40	37

Under the conditions of trial A the material was not sufficiently reduced, the pulp obtained containing some undisintegrated material ; it furnished a pale brown paper of fairly good strength. The pulp did not bleach readily, but on treatment with a strong bleaching solution it was reduced to a cream colour but still contained a number of dark brown specks.

The longer period of digestion employed in trial B furnished a fairly well-reduced pulp which yielded paper containing only a slight amount of undisintegrated material. The pulp bleached fairly readily to a pale cream colour and yielded paper of similar character to that obtained in trial A, but almost free from specks.

It is noteworthy that the yield of bleached pulp in trial B is 2 per cent. higher than in trial A. This is no



doubt attributable to the less severe bleaching treatment required in the case of B.

The results of these experiments show that Moraballi gives a fairly good yield of pulp which furnishes paper of moderate strength and is fairly readily bleachable.

### GENERAL CONCLUSIONS

The results obtained with the eleven woods are summarised in the following table. The consumption of caustic soda and the yields of pulp are expressed on material containing 12 per cent. of moisture in order to render the figures more readily comparable.

	Trial	Caustic soda used.		Conditions of digestion		Parts of caustic soda consumed per 100 parts of wood	Yield of dry pulp.	
		Parts per 100 parts of wood	Parts per 100 parts of solution	Time	Temp		Un-bleached.	Bleached.
				hrs	° C		Per cent.	Per cent.
No. 879. Greenheart .	A	20	4	5	160	8.69	42	41
	B	20	4	6	160	9.47	41	38
No. 880. Wallaba .	A	20	4	5	160	10.55	37	34
No. 881. Kakaralli .	A	20	4	5	160	10.94	48	41
	B	20	4	6	160	12.79	37	34
No. 882. Mora .	A	20	4	5	160	9.96	48	40
	B	20	4	6	160	10.75	41	35
No. 883. Yaruru .	A	20	4	6	160	12.2	45	44
No. 884. Itikibouroballi	A	20	4	5	160	9.5	42	36
No. 885. Trysil .	A	20	4	5	160	8.9	38	36
No. 886. Marashiballi .	A	20	4	5	160	11.3	46	39
	B	20	4	6	160	11.65	42	39
No. 887. Kautaballi .	A	20	4	5	160	10.4	47	43
	B	20	4	6	160	11.2	43	39
No. 888. Morabukea .	A	20	4	5	160	9.6	46	41
No. 889. Moraballi .	A	20	4	5	160	12.7	42	35
	B	20	4	6	160	12.8	40	37

The results of the examination of the woods show that most of them furnish good yields of well-digested pulp under similar conditions of treatment and with a comparatively low consumption of soda. The lowest yields of pulp were obtained from Wallaba and Trysil, viz. 37 and 38 per cent. respectively, these yields being rather lower than those usually obtained from the woods generally employed for the manufacture of wood pulp. All the woods gave rather short-fibred pulps, the average length of the fibre being, however, in most cases, greater than that of the fibre of poplar pulp (1.1 mm.).

The best paper was obtained from Wallaba, Mora, Trysil and Morabukea. The pulps from these woods were stronger and bleached more satisfactorily than those obtained from the other woods. The pulps from Wallaba and Mora bleached readily, but a rather large amount of bleaching liquor appears to be needed for the pulps from Trysil and Morabukea.

The pulp from Moraballi wood was of fairly good quality and the yield was satisfactory, but the ultimate fibres were shorter and coarser than those derived from the four woods mentioned in the preceding paragraph ; moreover, the pulp did not felt so well as the pulps from those four woods and the paper was appreciably weaker.

Greenheart, Kakaralli, Itikibouroballi and Marishiballi furnished satisfactory yields of pulp which could only be bleached with difficulty and furnished papers which were softer than those obtained from the five woods previously referred to, and were of only moderate strength.

The remaining two samples of wood, Yaruru and Kautaballi, gave good yields of pulp, but in neither case could the pulp be readily bleached and the papers were soft and weak and generally of very poor quality.

## CINCHONA BARK FROM UGANDA

REFERENCE has already appeared in this BULLETIN to the efforts that have been made in certain parts of Africa to introduce the cultivation of Cinchona and reports on samples of the bark from Tanganyika and the Cameroons have been published (1918, 16, 386 ; 1920, 18, 22).

Two samples of cinchona bark produced in Uganda have been examined at the Imperial Institute recently and the results of their investigation are given in the following pages. The first sample, received from the Forestry Department in January 1927, consisted of bark which, in the opinion of Professor H. G. Greenish, F.I.C., was derived from *Cinchona succirubra*. The second sample was forwarded by the Director of Agriculture in June 1927, and the trees yielding it were stated to be probably *Cinchona robusta*, but this identification is subject to confirmation later.

1. *CINCHONA SUCCIRUBRA* BARK

This bark was derived from trees just over five years old, raised from seed obtained from the Government Cinchona Plantation, Munşong, Kalimpong, Bengal. The growth of the trees was stated to be very satisfactory, many of them being over 14 ft. in height and 3 in. in diameter in November 1926, whilst one, which was left undisturbed in the nursery bed, was 20 ft. in height and over 6 ft. in diameter. The number of trees from which the bark was stripped was 28 and the yield of fresh bark (exclusive of that from small branches and tiny roots) was 63 lb. 5 oz.

It was desired that the bark should be submitted to examination and the results compared with those yielded by bark from trees of approximately the same age from other sources.

The sample of bark received at the Imperial Institute weighed 20 lb. on arrival, and consisted of quills of bark varying somewhat in appearance and thickness. They were from 5 to 13 in. long and from  $\frac{1}{8}$  to  $\frac{1}{6}$  in. thick. The outer surface was pale brown with occasional patches of grey lichen. It showed longitudinal furrows which in some pieces were well marked and in others very slight, and occasional transverse lines or cracks extending completely round the quill. The inner surface of the bark was tawny brown.

On chemical examination the bark furnished the results given in the following table :

	Expressed on sample as received. Per cent.	Expressed on moisture-free material. Per cent.
Moisture . . . . .	9.4	—
Total alkaloids : . . . .	6.85	7.56
Including quinine * . . . .	3.72	4.11
* Equivalent to crystalline quinine sulphate . . . . .	5.05	5.57

## REMARKS

It was desired by the authorities in Uganda to obtain information regarding the usual percentage of quinine in cinchona bark from trees about five years of age, and the following observations were therefore furnished.

Variety of Bark.	Country where grown.	Age of tree.	Quinine in bark. Per cent.	Quinine in bark (expressed as quinine sulphate). Per cent.	Total alkaloids in bark. Per cent.	Remarks.
<i>C. Ledgeriana</i> <sup>1</sup>	Madras	years. 5½	8.4	—	9.91	Average sample from 21 trees
do. narrow leaves <sup>2</sup>	"	6	—	4.09	5.97	
do. broad leaves <sup>2</sup>	"	6	—	2.90	6.61	
do. <sup>3</sup>	"	4½	4.97	—	7.54	Averages of large numbers of analyses
"	"	5	4.57	—	7.05	
"	"	5½	5.09	—	6.70	
"	"	4½	7.54	—	9.00	
"	"	5	1.02	—	5.94	
"	"	5½	1.23	—	6.83	
<i>C. succirubra</i> <sup>3</sup>	"	5½	1.32	—	7.21	Average of bark from 12 trees
do. <sup>3</sup>	"	6	—	1.34	5.00	
do. <sup>3</sup>	"	12	—	2.43	7.41	
<i>C. Calceyae</i> <sup>3</sup>	Colombia	3	3.24	4.32	—	Bark from coppiced shoots
<i>C. officinalis</i> <sup>3</sup>	"	3½	3.49	4.66	—	
<i>C. succirubra</i> <sup>3</sup>	"	3	3.75	4.94	—	
<i>C. officinalis</i> <sup>4</sup>	Madras	6½	2.91	—	5.10	Bark from coppiced shoots
<i>C. Ledgeriana</i> and <i>C. succirubra</i> hybrids <sup>4</sup>	G E. Africa	4	1.9 to 2.1	6.4 to 6.8	—	
<i>C. succirubra</i> <sup>4</sup>	Tanganyika	5	—	—	7 to 7.9	

*Hooper*, "Year Book of Pharmacy," 1885, 503.  
*Hooper*, "Year Book of Pharmacy," 1886, 557, and 560.  
*Howard*, "Year Book of Pharmacy," 1886, 653.  
*Hooper*, "Year Book of Pharmacy," 1887, 560.  
*Hesse*, "Year Book of Pharmacy," 1907, 40 (from "Apoth. Zeit."  
 "Report of the Department of Agriculture, Tanganyika Territory,"

The data available regarding the percentage of quinine in cinchona bark from trees of particular ages are somewhat variable. Hooper has stated that in the case of Ledger barks "there is a steady rise of quinine up to the age of between five and six years, after which there is no apparent increase." He also reported that red bark attains "its maximum content of alkaloid when between five and six years of age. The quinine increases up to twelve years." In a study of cinchona bark collected annually from one plantation Van Leersum found that the maximum quinine percentage was reached in five years, after which a gradual decrease took place. Sands has expressed the opinion that the percentage of quinine in the bark increases at least up to the fifth year of production (trees of eight to nine years of age).

On the other hand Howard states that the yield of alkaloid from "trees grown side by side, all from the same cultivation of the same seed in the same soil, differs widely, and a great number of analyses of individual trees showed . . . that the variation must be in the trees and not in the condition of growth." Similar statements have been made by other authorities.

In view of these conflicting statements it does not appear likely that any definite conclusions could be drawn from a comparison of the figures recorded for bark from five-year-old trees from different sources, but such figures as are available for different species of cinchona about five years old are given in the table on p. 19.

### Conclusions

This sample of cinchona bark from Uganda contains a very satisfactory amount of quinine (3.72 per cent.) for *Cinchona succirubra* bark, which generally contains about 6.5 per cent. of total alkaloids and only about 1.5 per cent. of quinine. In alkaloidal content the bark more resembles that of *Cinchona Calisaya*, which usually contains about 6 to 7 per cent. of total alkaloids, including 3 to 4 per cent. of quinine. As a source of quinine the bark would, however, be inferior to Ledger bark of good quality, which usually contains about 9 per cent. of total alkaloids and 7 to 8 per cent. of quinine.

2. *CINCHONA ROBUSTA* (?) BARK

The trees from which this bark was derived were six years old and were grown at the Bukalasa Plantation from seed obtained from the Amani Institute. They were planted at distances of 6 ft.  $\times$  6 ft. on sandy soil in a shallow valley about 50 yards from a swamp.

The bark was obtained by coppicing, the trees being cut down to the ground level and the bark completely removed from all large branches and stems. Five trees produced 22 lb. of dried bark, representing an average yield per tree of nearly  $4\frac{1}{2}$  lb.

The sample received at the Imperial Institute weighed about 10 lb. on arrival, and consisted of quills of bark varying greatly in appearance, size and thickness. The length of the quills ranged up to a maximum of  $8\frac{1}{2}$  in. and the thickness of the bark from about  $\frac{1}{4}$  to  $\frac{5}{16}$  in. The quills were coated to a varying extent with patches of yellowish-green or grey lichen and showed transverse cracks but no well-marked longitudinal furrows. The thinner bark was pale dull brown on the outer surface and bright yellow brown on the inner surface. The thicker bark was rough and dark brown externally but fairly smooth and of a medium brown colour on the inner surface.

On chemical examination the bark furnished the results given in the following table in comparison with those obtained with a sample of *Cinchona robusta* bark received at the Imperial Institute from the Amani Institute in 1918.

	Present Sample.		Sample from the Amani Institute.	
	Expressed on sample as received.	Expressed on moisture-free material.	Expressed on sample as received.	Expressed on moisture-free material.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Moisture . . . . .	10.3	—	8.1	—
Total alkaloids . . .	6.95	7.75	7.61	8.28
Including quinine * . .	2.74	3.05	2.66	2.90
* Equivalent to crystalline quinine sulphate . . . . .	3.72	4.15	3.55	3.84

These results show that the present sample of cinchona bark from Uganda closely resembles in composition the

previous sample of *Cinchona robusta* bark from the Amani Institute.

A sample of the bark, together with the results of analysis, was submitted to a firm of brokers for valuation. They described the material as "mixed broken, stem branch and twig bark, thin and papery, fairly bright and a little mossy," and regarded its value for manufacturing purposes as about 4*d.* to 4½*d.* per lb. ex wharf London (October 25, 1927). They added that such bark would probably meet with a fairly ready demand at this price.

The results of the investigation of this cinchona bark show that the amounts of total alkaloid and of quinine resemble those present in *C. Calisaya* bark which usually contains about 6 to 7 per cent. of total alkaloids including 3 to 4 per cent. of quinine. Consignments of similar character to the present sample would probably be readily saleable in London for manufacturing purposes, although as a source of quinine it is inferior to Ledger bark of good quality.

*C. robusta* bark cannot be used for making the official cinchona preparations of the British Pharmacopœia, for which purpose *C. succirubra* is alone specified.

## ARTICLES

### TANNING MATERIALS OF THE BRITISH EMPIRE

#### PART III

IN the previous parts of this article (this BULLETIN, 1927, 25, 250 and 380) an account has been given of the production in the British Empire of the more important barks, woods and leaves which serve as tanning materials. The present part deals chiefly with the fruits used for this purpose, viz. myrobalans, divi-divi pods, algarobilla pods, teri pods and *Acacia arabica* pods; reference is also made to canaigre, the tubers of the "red dock" or "wild rhubarb."

#### MYROBALANS

The astringent fruits, known as myrobalans, of several species of *Terminalia*—an extensive genus distributed over the tropics of the world—have long been employed for tanning purposes by the natives of India and are now exported in large quantities. The most important com-

mercial species is *T. Chebula* Retz., the chebolic or black myrobalan, which in Europe is the best known of the Indian tanning materials. The production and marketing of this product were fully dealt with in a *Report on the Trade in Indian Myrobalans*, furnished to the Secretary of State for India by the Imperial Institute Special Committee on Hides and Tanning Materials, and published in the series of Indian Trade Enquiry Reports (London: John Murray, 1922). *T. Chebula* occurs throughout India and Burma as a deciduous tree which varies in size according to the locality and conditions of growth. In forests it attains a height of from 40 to 50 ft., and affords a useful timber. The trees and their fruits are subject to so much variation that several different forms or varieties are recognised. The commercial supplies of myrobalans are largely derived from privately-owned forests, but are also obtained from forests belonging to the Indian Government or to Native States. Five different varieties are known on the English market, which are named after the districts where they are marketed :

- (1) " Bhimlies " from Bimlipatam in Madras ;
- (2) " Rajpores " from Bombay ;
- (3) " Jubbelpores " from Jabbalpur in the Central Provinces ;
- (4) " Vingorlas " from the Bombay forests ;
- (5) " Madras Coast."

There are usually two grades of each of these varieties.

Some uncertainty has existed as to the best time for gathering the fruits. Bhimlies and Jubbelpores, which are the most esteemed varieties, are generally collected in the green, unripe condition. Bombay fruits, on the other hand, are gathered when riper. The latter have smoother skins and larger wrinkles, and are often rather soft, waxy and spongy. As a rule they are not in so much favour with tanners, although they frequently contain a higher percentage of tannin. The examination at the Imperial Institute some years ago of samples of Bombay myrobalans in different stages of development showed that the riper fruits contained the most tannin. This has been confirmed in a more recent investigation in India on the best season for collection. The fruits examined were obtained from



Madras and the Central Provinces, and it was recommended that they should be gathered as soon as they were fully ripe, when they were the richest in tannin. The commercial value of myrobalans is, however, not governed altogether by the percentage of tannin they contain, but depends also on various other qualities which render some varieties more suitable than others for producing certain classes of leather. For instance Jubbelpores have been shown to be the most valuable for weight-producing. Moreover this variety and Vingorlas have been found to furnish the largest amount of "bloom." This is mostly formed during the early stages of tanning, whereas in the case of most of the other varieties the greater part of the "bloom" is deposited later.

The following table shows the percentage composition of samples of the chief commercial varieties of myrobalans examined at the Imperial Institute, together with the figures obtained by Parker and Blockey (*Journ. Soc. Chem. Indust.*, 1903, 22, 1182), for carefully selected average commercial samples. The results have been re-calculated to a uniform moisture content of 10 per cent.

	Tannin		Extractive matter (non tannin)		Soluble matter		Ash.
	Imperial Institute	Parker and Blockey	Imperial Institute	Parker and Blockey	Imperial Institute	Parker and Blockey	Imperial Institute.
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent.
Bhimlies—B <sub>1</sub>	32.5	39.3	16.4	16.5	41.1	34.2	2.6
" B <sub>2</sub>	27.3	36.0	16.4	14.5	46.3	39.5	2.6
Jubbelpores—J <sub>1</sub>	34.6	37.3	15.0	14.7	40.4	38.0	3.1
" J <sub>2</sub>	25.5	27.9	17.7	14.4	46.8	47.7	2.9
Rajpores—R <sub>1</sub>	35.6	36.2	14.0	12.4	40.4	41.4	2.4
" R <sub>2</sub>	24.3	28.2	15.6	13.0	50.1	48.8	2.2
Vingorlas—V <sub>1</sub>	29.6	32.2	13.3	9.7	47.1	48.1	2.3
" V <sub>2</sub>	24.3	—	15.1	—	50.6	—	2.3
Fair Coast Madras	—	35.5	—	15.7	—	38.8	—

The estimation of tannin at the Imperial Institute in a number of samples of myrobalans received from India some years ago furnished the following results :

	Percentage of tannin expressed on whole fruits containing 10 per cent of moisture.	
	Minimum	Maximum.
Bombay (43 samples)	25.1	42.3
Madras (15 samples)	19.6	44.8
Burma (7 samples)	7.7	31.0

In view of the great variation in the amount of tannin in these samples, it seemed desirable to ascertain whether this was due to the variety of tree or to the locality in which the fruits were grown. An application for further samples was accordingly made, and about fifty samples were duly received during the years 1922 and 1924 from the Forest Botanist at Dehra Dun. The fruits were derived from various species of *Terminalia*, but mostly *T. Chebula*, and were obtained from different parts of the country. The results of this investigation were published in this BULLETIN (1924, 22, 123, 413), and are summarised in the following table :

Presidency or Province.	Species.	Number of samples	Percentage of tannin expressed on whole fruits containing 10 per cent. of moisture	
			Minimum	Maximum.
Madras . . .	<i>T. Chebula</i> Retz.	21	25.6	49.0
Bombay . . .	" "	2	31.3	35.9
United Provinces . . .	" "	7	19.8	30.2
Punjab . . .	" "	3	25.7	36.1
Central Provinces . . .	" "	4	30.1	36.7
Madras . . .	<i>T. pallida</i> Brandis	4	19.0	38.3
Burma . . .	<i>T. tomentella</i> Kurz	3	14.1	19.2
Madras . . .	<i>T. travancorensis</i> W. & A.	1	31.5	
Assam . . .	<i>T. citrina</i> Fleming	1	26.2	

The results of this examination showed that the fruits of *T. Chebula* from different districts varied widely in appearance and in the quantity of tannin they contained. Fruits from the Salem Division of Madras, of which 12 samples were examined, contained the highest percentage of tannin, the average amount being about 42 per cent. This is considerably higher than the average tannin content of good commercial myrobalans, which is about 32 per cent. Fruits of the other species generally contained less tannin than those of *T. Chebula*. As only a few samples of these other species of fruits were included, further samples would have to be examined before definite conclusions could be drawn as to their relative values.

Two samples of fruits were forwarded which are not recorded in the above table. These were described as *T. Chebula* from Burma, but their appearance was quite distinct from all the samples of *T. Chebula* from India.

They were identical with the four samples of *T. tomentella* from Burma, and contained correspondingly low amounts of tannin, namely 12 and 17.3 per cent. respectively. According to the *Indian Forest Bulletin* No. 32 (1916) the identification of the so-called *T. Chebula* of Burma with the *T. Chebula* of India is doubtful. Kurz has regarded the Burma myrobalans as *T. tomentella*, which, however, is classified by Hooker as a variety of *T. Chebula*. Seventeen samples of these myrobalans collected from various parts of Burma, and examined in India by Puran Singh, were also found to contain only about half as much tannin as the Indian fruits, and generally an excess of soluble non-tannins. The tannage of Burmese myrobalans resembles that of the Indian fruits, the leather being of similar quality but darker in colour.

Myrobalans are one of the most important tannin materials of the pyrogallol class. The tannin is not very astringent, and penetrates the hide very slowly. When used alone they yield a soft mellow and rather spongy leather which does not possess good wearing properties. They are therefore usually blended with the most astringent and quick penetrating tannins, such as quebracho, wattle and mangrove, the red colour of which is thereby neutralised, and a brighter, more satisfactory colour is imparted to the leather. In India these fruits are largely employed in conjunction with babul (*Acacia arabica* Willd.), avaram (*Cassia auriculata* L.) and mangrove barks, and also as a "bleaching" agent at the end of the tannage of the East India kips of Madras and Bombay. One of the principal properties of myrobalans is their acid-forming power. They contain from about 3 to 5 per cent. of sugary matter, which is considerably more than is present in most tanning materials, and fermentation therefore readily takes place and satisfactory plumping is secured during the early stages of tanning. Myrobalans moreover contain a large proportion of ellagitannic acid, and are therefore one of the chief bloom-yielding tanning materials and are especially useful in the production of sole leather. They are not, however, considered a good weight-giving tan-stuff as the proportion of tannin combining with the hide substance is small as compared with other tanning materials.

Experiments conducted with Empire tanning materials during the war, when there was a shortage of foreign supplies, established the value of the mixed tannage of myrobalans and wattle bark. The astringent, readily penetrating wattle liquors are mellowed by the addition of myrobalans which, through natural fermentation, provide the necessary degree of acidity, and render the leather brighter in colour while diminishing its tendency to become red on exposure to light.

The following figures have been published, showing the relative speeds of penetration, and also the gains in weight of the dry pelt afforded by some of the principal commercial tanning materials. It will be seen that, with the exception of Canaigre (*Rumex hymenosepalus* Torr.), myrobalans possess the slowest penetration powers and are the most inferior in weight-giving of all the materials enumerated.

						Speed of penetration of different tanning materials. Minutes
Quebracho extract	.	.	.	.	.	2
" wood	.	.	.	.	.	3
Oak bark	.	.	.	.	.	6
" wood (not decolourised)	.	.	.	.	.	9
Hemlock extract	.	.	.	.	.	10
Wattle bark	.	.	.	.	.	11
Oak wood (decolourised)	.	.	.	.	.	12
Chestnut.	.	.	.	.	.	13
Valonia	.	.	.	.	.	17
Myrobalans	.	.	.	.	.	60
Canaigre	.	.	.	.	.	9½ hours

						Gain in weight of dry pelt with different tanning materials Per cent.
Oak bark	.	.	.	.	.	105.6
Valonia	.	.	.	.	.	103.4
Oak wood (not decolourised)	.	.	.	.	.	102.7
" " (decolourised)	.	.	.	.	.	100.7
Chestnut	.	.	.	.	.	99.6
Quebracho extract	.	.	.	.	.	99.1
" wood	.	.	.	.	.	98.4
Wattle bark	.	.	.	.	.	94.5
Canaigre	.	.	.	.	.	94.3
Hemlock extract	.	.	.	.	.	93.4
Myrobalans	.	.	.	.	.	75.6

In addition to their employment in the tanning industry, appreciable quantities of myrobalans are used as a

dye, and as a mordant in the dyeing of cotton, and also for the weighting of black silk and in the manufacture of ink.

The sun-dried fruits are generally picked over before being shipped in bags, which vary in weight according to the port of consignment. In Madras the bags weigh 164 lb. each, in Calcutta 56 lb., and in Bombay 140, 168 or 182 lb. As the stones of the myrobalans constitute from about 20 to 50 per cent. of the fruit, and contain only about 2 to 4 per cent. of tannin, their removal would furnish a product containing about 20 per cent. more tannin and would at the same time effect a considerable economy in freight. Consignments of stoneless crushed myrobalans when first exported to Europe (about 1911) appear to have been principally consumed by Continental tanners. During the war, owing to transport difficulties, increased quantities of crushed myrobalans were shipped and met with more extensive employment in this country. The crushed product, however, has been slow to find favour with British tanners, largely owing to the fact that the material in this form lends itself so readily to adulteration, and also to contamination with unsound fruits. Moreover, as already mentioned, preference is given by different tanners to certain varieties and grades of myrobalans, and without being able to handle the whole fruits they can never be certain of securing the grade they require. Crushed myrobalans are now quoted regularly on the English market at a price about one-third as much again as that of the whole fruits, the product containing about 45 per cent. of tannin.

The following tables show the exports of myrobalans (including the crushed fruits) from India, and also the trade of the United Kingdom in this commodity for the five years ending 1925-26. It will be seen that the United Kingdom, with an import which fluctuated a good deal during this period, was the largest consumer save for the year 1921-22, when a somewhat greater amount was shipped to Germany. The direct exports to the latter country, however, show an almost steady decrease, the quantity in the year 1925-26 being little more than one-sixth of that exported to the United Kingdom. Shipments to the United States rank next in importance, the consumption being a fairly steady one of about 300,000 cwts.

*Exports of Myrobalans from India*

	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.
<b>Total Exports</b>					
<i>quantity (cwts.)</i>	1,238,937	1,440,759	1,324,751	1,339,359	1,042,557
<b>Total Exports</b>					
<i>value (rupees)</i>	5,866,593	7,400,512	7,262,422	7,935,561	7,372,222
	<i>Cwts.</i>	<i>Cwts.</i>	<i>Cwts.</i>	<i>Cwts.</i>	<i>Cwts.</i>
United Kingdom . . . . .	362,711	638,576	588,164	653,725	478,981
Australian Common-wealth . . . . .	25,411	18,230	25,099	10,700	27,209
Ceylon . . . . .	1,022	5	192	2,679	1,923
Straits Settlements, including Labuan . . . . .	550	133	93	268	304
Hong Kong . . . . .	11,473	5,869	6,403	7,642	2,937
Cape of Good Hope . . . . .	800	2,659	3,100	2,200	1,998
Other British Possessions . . . . .	366	210	100	27	59
<b>Total British Empire</b>	402,357	665,682	623,151	677,283	513,739
Germany . . . . .	396,499	242,908	143,932	165,194	81,759
Netherlands . . . . .	24,309	11,001	14,359	34,308	22,052
Belgium . . . . .	65,047	67,901	62,690	71,413	44,427
France . . . . .	40,380	93,220	102,993	113,448	67,162
Italy . . . . .	600	7,757	16,969	10,033	200
Japan . . . . .	37,555	10,400	15,590	23,484	23,062
United States . . . . .	270,187	333,856	326,390	227,535	282,995
Other Foreign Countries . . . . .	2,003	8,034	18,677	16,661	7,161
<b>Total Foreign Countries</b>	836,580	775,077	701,600	662,076	528,818

*United Kingdom Trade in Myrobalans*

	1922.	1923.	1924.	1925	1926. <sup>1</sup>
<b>Total Imports</b>					
<i>quantity (cwts.)</i>	505,642	492,007	757,151	539,309	623,893
<b>Total Imports</b>					
<i>value (£)</i>	184,430	188,158	319,582	315,022	311,555
	<i>Cwts.</i>	<i>Cwts.</i>	<i>Cwts.</i>	<i>Cwts.</i>	
British India . . . . .	501,043	489,672	752,768	533,958	
Other British Countries . . . . .	2,000	—	1,470	2,972	
<b>Total British Countries</b>	503,043	489,672	754,238	536,930	
<b>Total Foreign Countries</b>	2,599	2,335	2,913	2,379	

*Re-exports*

<b>Total Re-exports</b>					
<i>quantity (cwts.)</i>	15,082	5,456	13,091	23,430	22,914
<b>Total Re-exports</b>					
<i>value (£)</i>	4,469	1,953	5,797	13,621	11,326
	<i>Cwts.</i>	<i>Cwts.</i>	<i>Cwts.</i>	<i>Cwts.</i>	
<b>Total British Empire</b>	58	128	330	290	
Sweden . . . . .	95	—	—	504	
Germany . . . . .	10,205	1,073	3,341	14,483	
Belgium . . . . .	400	—	—	665	
France . . . . .	2,958	1,176	4,945	1,743	
United States . . . . .	967	1,867	4,370	4,645	
Other Foreign Countries . . . . .	399	1,212	105	1,100	
<b>Total Foreign Countries</b>	15,024	5,328	12,761	23,140	

<sup>1</sup> Full details not yet available.

In addition to whole and crushed myrobalans, the solid extract has for many years been a regular article of commerce, and considerable quantities are now exported, generally in solid blocks containing between 50 and 60 per cent. of tannin. Solid extract of myrobalans is prepared in the East Indian Tanning Extract Factory, Raniganj, Bengal, which Presidency, according to the official returns, is responsible for practically the whole of the extract exported from India. It is usually packed in bags, cases or kegs, of about one hundredweight each. There is a good demand for it in the United Kingdom, which country, as will be seen in the accompanying table, showing the exports during the five years ending 1925-26, is by far the largest consumer. It is stated that this solid extract furnishes a far less satisfactory tanning material than the fruits themselves as regards the deposition of bloom, the formation of acid liquors, and the improvement in the colour of the leather. For this reason British tanners prefer as a rule to make for themselves a liquid extract containing from about 25 to 30 per cent. of tannin; considerable quantities of myrobalans are now utilised in this way.

*Exports of Myrobalan Extract from India*

—	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.
Total Exports <i>quantity (cwts.)</i>	39,944	60,888	62,344	42,619	30,567
"    " <i>value (rupees)</i>	488,914	834,069	840,781	536,454	389,422
<i>British Empire</i>	<i>Cwts.</i>	<i>Cwts.</i>	<i>Cwts.</i>	<i>Cwts.</i>	<i>Cwts.</i>
United Kingdom . . . . .	23,853	33,902	36,429	23,778	18,316
Cape of Good Hope . . . . .	1,838	1,972	1,673	1,444	1,925
Natal . . . . .	40	280	40	40	175
Canada . . . . .	—	—	358	696	—
Australian Commonwealth . . . . .	3,194	7,163	4,162	3,750	1,076
New Zealand (including Nauru and British Samoa)	202	212	20	224	—
Hong Kong . . . . .	—	400	48	—	—
Total British Empire . . . . .	29,127	43,929	42,730	29,932	21,492
<i>Foreign Countries</i>					
Germany . . . . .	4,039	6,386	4,186	2,618	2,658
Belgium . . . . .	2,324	2,060	3,097	1,191	375
France . . . . .	1,545	2,110	3,809	3,082	3,552
Italy . . . . .	821	642	2,524	2,101	930
Netherlands . . . . .	—	—	—	300	381
Japan . . . . .	—	—	243	—	22
United States . . . . .	1,149	3,978	4,063	1,242	763
Total Foreign Countries . . . . .	10,817	16,959	19,614	12,687	9,075

## DIVI-DIVI

Divi-divi is the name applied to the pods of a tree, *Casalpinia coriaria* Willd. (N.O. *Leguminosæ*). The tree is indigenous to Mexico, West Indies, Venezuela, Colombia and North Brazil. It has been successfully cultivated in India (especially in the Madras Presidency), Australia, Java, Tanganyika, Gold Coast and Mauritius. Mature trees are stated to yield 300 lb. of pods per annum. The pods contain on an average from 40 to 45 per cent. of tannin, and also appreciable quantities of glucose. The tannin in the pods is located in the tissue lying just beneath the epidermis, the seeds being free from it.

When used alone in tannage, divi-divi pods yield a leather which is strongly affected by climatic conditions. In damp weather the leather is soft and spongy, while in drought it loses its pliability. The pods are, therefore, generally blended with other materials, and are used chiefly as a partial substitute for gambier in dressing leather. They may also be utilised in the rapid drum-tannage of light leather.

On account of the high percentage of glucose in the pods the liquors are very liable to ferment, while at times they suddenly develop a deep red colouring matter. The use of antiseptics has been found to prevent the latter change. The problem of the fermentation is being investigated in India, where the pods are used in the local tanneries.

The chief countries from which the world's supplies of divi-divi pods are derived are Venezuela, Colombia, Dominican Republic, the Dutch West Indies, India and Jamaica. In Venezuela two factories were established during the war and manufactured a solid extract containing 80 per cent. of tannin.

The exports of pods from various countries for the years 1921-25 (inclusive) are shown in the table on p. 33.

Prior to 1914 Germany was the best market for this material, but since then the United States of America have occupied the premier position.

From the table it is seen that India and Jamaica are



the only parts of the British Empire that export divi-divi pods, and that the quantities from these sources are quite small in comparison with those from South America. In 1926-27, the total exports from India (Madras Presidency) amounted to 357,728 lb., which was shipped entirely to Germany, France and Belgium.

Trials have been carried out in several parts of the Empire to ascertain whether *C. coriaria* could be successfully grown there. In Tanganyika, cultural experiments carried out before the war proved satisfactory and showed that the conditions were suitable, pods containing as much as 42 per cent. of tannin being harvested. Divi-divi grown in the Gold Coast was found on examination at the Imperial Institute to be low in tannin (33 per cent.) when compared with pods from Central America (40-45 per cent.). Similar low results were obtained with divi-divi grown in Mauritius and in Queensland, as is shown in the following table of analyses carried out at the Imperial Institute with divi-divi from various parts of the British Empire.

*Results of Examination of Divi-divi Pods at Imperial Institute*

—	Madras.		Mauritius			Gold Coast	Queensland. <sup>1</sup>
Moisture . . . . . per cent.	9.3	9.6	11.3	12.2	8.8	14.4	15.9
Insoluble matter . . . . . per cent.	23.9	27.1	42.9	39.4	38.1	37.9	26.6
Extractive matter (non-tannin) . . . . . per cent.	24.9	21.5	24.6	22.5	21.1	14.6	14.3
Tannin . . . . . per cent.	41.9	41.8	21.2	25.9	32.0	33.1	43.2
Ash . . . . . per cent.	2.3	2.3	2.4	2.2	2.5	1.3	2.2
Tintometer Readings—							
Red . . . . .	3.0	2.1	4.6	6.5	3.5	—	—
Yellow . . . . .	10.5	5.3	26.2	33.2	10.8	—	—

<sup>1</sup> Pods free from seeds.

Tanners in the United Kingdom are prepared to use greater quantities of divi-divi pods and would welcome increased supplies. Extension of the cultivation can therefore be recommended as the product would find a ready market.

*Exports of Divi-divi (lb.)*

Whence exported	1921-22	1922-23	1923-24	1924-25	1925-26
India: Madras Presidency, to					
United Kingdom . . .	124,208	292,656	216,272	89,600	242,816
Germany . . . . .	384,720	303,408	285,152	643,216	295,680
Belgium . . . . .	—	22,176	1,792	—	—
France . . . . .	—	—	—	12,096	89,600
Italy . . . . .	—	—	—	68,992	—
Japan . . . . .	109,312	—	—	—	—
Total for Madras Presidency . . .	618,240	618,240	503,216	813,904	628,096
	1921.	1922.	1923.	1924.	1925.
Jamaica to:					
United Kingdom . . .	—	137,857	141,194	210,040	—
Belgium . . . . .	—	—	—	—	40,437
Germany . . . . .	302,971	13,297	2,250	89,951	148,211
Netherlands . . . .	—	28,355	58,284	27,332	56,226
Total for Jamaica . . . . .	302,971	179,509	201,628	327,323	244,874
Colombia . . . . .	— <sup>1</sup>	3,508,768	4,522,608	— <sup>1</sup>	— <sup>1</sup>
Curaçao . . . . .	1,785,240	(£27,600)	(£1,200)	— <sup>1</sup>	— <sup>1</sup>
Venezuela . . . . .	— <sup>1</sup>	6,920,560 <sup>2</sup>	9,214,924	7,918,972	8,029,172

<sup>1</sup> Figures not available.<sup>2</sup> Six months only, July-December.

## ALGAROBILLA

The pods of the plant *Cæsalpinia brevifolia* Baill., well known to the tanners of the United Kingdom and other countries as Algarobilla, contain about 45 per cent. of tannin, and are similar in character to divi-divi, but less prone to cause discoloration. The world is dependent on Chile for supplies, but the export from that country is very irregular. It amounts in some years to 2,000 tons, of which the United Kingdom and Germany are the principal consumers. The algarobilla bush is not known to occur in a wild state in any part of the British Empire, and attempts to cultivate it have hitherto been unsuccessful. The bush is a native of Chile, where it grows inland at heights from 1,000 to 4,000 feet above sea level. It is very hardy and drought-resistant. In its natural habitat the winters are cold with frosty nights and some snow. Four inches of rain or its equivalent in snow during the winter is enough to ensure a good crop of pods, and a dry summer is stated to be necessary. For many years a regular and larger supply of pods has been desired by English tanners, and in 1910 the Imperial Institute initiated

cultivation trials in those countries of the Empire where the climate appeared promising for the purpose. A supply of seed was obtained from Chile and distributed to Rhodesia, Cape Province, Uganda, Kenya, Cyprus and India, but the results were unsatisfactory. Prior to these experiments seed had been distributed from Kew as far back as 1875 to Australia, the Bahamas, Barbados, Bermuda, South Africa and India. The cultivation of the plant did not prove successful in any case. This was attributed to the peculiar requirements of the plant as regards climate, and it was considered doubtful whether there existed within the Empire an area which possessed a cool climate combined with so small a rainfall as that belonging to the natural habitat. As a result of representations made recently by the United Tanners' Federation to the Imperial Institute Advisory Committee on Tanning Materials on the desirability of algarobilla production within the Empire, the possibilities of Empire cultivation are being re-investigated, and for this purpose seed has been distributed from Kew to Australia, South Africa, Kenya, Tanganyika, Nigeria, Cyprus and Bermuda.

#### TERI PODS

The pods of *Casalpinia digyna* Rottl. provide a tanning material similar to divi-divi and algarobilla. The plant is a thorny, scandent shrub found plentifully in a wild state in many parts of Burma, and in Bengal and Assam. The pods have been examined at the Imperial Institute and found to contain from 22 to 27 per cent. of tannin, while the pod-cases, free from seeds, contained up to 52 per cent., these results being expressed on material containing about 13 per cent. of moisture. In tanning trials the pods compared very favourably with divi-divi, and were well spoken of by tanners as being suitable for both light and heavy leather tannages. Occasional small consignments have been disposed of in this country, but it was found that the wild pods could only be procured in small quantities and at an excessive cost on account of the difficulty of collection, consequent upon the thorny nature of the shrub. The plant is abundant, but the pods do not appear to be used to any great extent in India as a tanning material.

*ACACIA ARABICA* (SANT, BABUL or GAMBIA) PODS

The pods of *Acacia arabica* Willd. contain up to 34 per cent. of tannin, while, after the removal of the seeds, which are practically free from tannin, the remaining pod-cases contain over 40 per cent. The pods are used for tanning purposes in the Sudan, and to some extent in India, where they are known as Babul pods. They have also from time to time been imported into the United Kingdom from West Africa, under the designation of Gambia pods. The pods form an important source of tannin for use in the countries of origin, but attempts to establish a market in Europe have so far not been successful.

**Sudan.**—In the Sudan the pods are known as sant, sunt or garad pods. The sant trees occur abundantly in the forests of the Blue Nile and the White Nile as far south as parallel 12° N. Sant pods from the Sudan have been examined at the Imperial Institute (see this BULLETIN, 1906, 4, 95 ; 1913, 11, 408), and found to contain about 30 per cent. of tannin. The seeds, which are very hard, amount to about 30 per cent. of the pods, and contain practically no tannin ; they are troublesome to the tanner, owing to the ease with which they ferment and the consequent rapid deterioration of the tan liquor. The tannin is located chiefly in a hard resinous-like deposit on the inner surface of the pods. A product known as " Sant Grains " has been prepared in the Sudan by crushing the pods and removing the seeds and most of the shell or pod-case by sifting. The " sant grains " so produced, amounting to about one-third of the entire pod, contain from 50 to 60 per cent. of tannin, depending largely on the extent to which the fibrous matter has been removed. Several trial consignments of the grains, produced by hand labour, have been forwarded to this country and favourably received, but the price obtained for the later shipments (1921) was not remunerative. Both the pods and the grains yield a pinkish-white leather which is fairly soft and of firm texture. Tanners who conducted technical trials with the material employed it in place of sumach for finishing skins tanned with bark, and reported that the results appeared to be quite satisfactory.

The tree is abundant in the Sudan and large supplies of the pods are available. They are used locally for tanning, and small quantities are regularly exported to Egypt, and occasionally to Italy. The quantity sent annually to Egypt varies from about 500 to 1,200 tons. It is stated that 2,000 tons of sant grains could be produced annually in the Sudan, but the development of a trade in the grains would be dependent on the introduction of suitable machinery in order to market the product at a remunerative price. The Sudan pods are a valuable and important Empire source of tannin and further efforts are now being made to place the material in a suitable form on the United Kingdom market. Efforts in this direction are being made under the auspices of the Imperial Institute Advisory Committee on Tanning Materials.

						Analyses made at the Imperial Institute.	
						Sant Pods freed from seeds.	Sant Grains.
						Per cent.	Per cent.
Moisture	.	.	.	.	.	7.8	5.9
Ash	.	.	.	.	.	4.5	3.7
Tannin	.	.	.	.	.	38.9	60.9
Extractive matter (non-tannin)	.	.	.	.	.	15.7	21.7
Tintometer readings :							
Red	.	.	.	.	.	1.3	—
Yellow	.	.	.	.	.	2.6	—

**India.**—As already stated (this BULLETIN, 1927, 25, 285) the *Acacia arabica* tree is common in Upper India, where it is known as Babul, and is greatly valued in that country on account of its bark. The bark forms the most important tanning material of the Cawnpore leather industry, but the pods, owing to their fermentative properties, have been utilised to only a small extent. These pods compare unfavourably in tannin content with the sant pods from the Sudan, containing only from 8 to 19 per cent. of tannin in the entire pods, and about 27 per cent. after the removal of the seeds ; they are, however, richer in tannin than the bark, and form an abundant source of tannin which should be of great importance when a successful method of application has been devised. At

present the pods are used as a cattle food in certain areas, but much of the material is entirely wasted. They are used to some extent by local dyers as a mordant for dyeing basic colours on cotton, and by tanners for drenching or bating, as after the liquor has fermented it is well adapted for the latter purposes. In 1915 investigations were commenced at the Technical Laboratory, Department of Industries, Cawnpore, for the purpose of determining the best means of overcoming the fermentation of the seeds in tanning operations. It was found that the fermentation could be sufficiently retarded by the use of an antiseptic so as to permit of the use of the pods in the same way as myrobalans. The antiseptic recommended was crude carbolic acid in the proportion of 0.3 to 0.5 per cent. of the weight of the pods used. It was intended to carry out trials on a commercial scale, but no further information has been published in this connection.

**West Africa.**—*Acacia arabica* is common in the dry zone throughout West Africa, and the pods are employed locally as a tanning material. In Nigeria they are known as Gabarru, and are largely used in the production of Kano leather. From time to time small quantities have been imported into the United Kingdom under the name "Gambia" pods, while the pods from the French possession of Senegal have recently attracted notice under the name "Gonakie" pods. Pods (including the seeds) from Northern Nigeria examined at the Imperial Institute were found to contain 27 per cent. of tannin, and yielded a pale fawn-coloured, rather soft leather (see this BULLETIN, 1913, 11, 411). Gonakie pods contain from 22 to 30 per cent. of tannin when ripe, while the half-ripe pods contain 40 per cent. or over. No regular export of these pods from West Africa has been established, though Senegal in 1922 exported over 500 tons. The pods are comparable as a tanning material with the sant pods of the Sudan, and would be of importance to European tanners when once the difficulty of application already referred to had been overcome.

#### CANAIGRE

The tubers of *Rumex hymenosepalus* Torr. contain in the fresh state about 9 per cent. of tannin and 68 per cent.

of water, but when dried they contain on an average 30 per cent. of tannin, the amount ranging from about 18 to as much as 48 per cent. This plant, which is sometimes known as "red dock," "wild rhubarb" and "tanners' dock," occurs in the sandy plains of Mexico and Texas, and attracted attention many years ago as a source of tannin. It has, however, never fulfilled expectations, the chief difficulty in the way of the establishment of a canaigre industry being the fact that the supplies of the wild plant are not sufficient to furnish a steady production in such quantities as would be required by the trade, and farmers have not found it sufficiently profitable to cultivate. The plant is an annual, and is easily reproduced from tubers. The tubers, for tanning purposes, are left in the ground for two years before lifting as the tannin content increases up to the second year. After this stage the colour darkens and the quality of the material deteriorates. Poor soil conditions favour a high percentage of tannin, while on rich, well irrigated soil the content is low. Trials have been made with the cultivation of this plant in Queensland and in the United Provinces, India. In the former country it is reported to have been successful, but in India the acclimatised tubers were found to contain only about one-half the amount of tannin usually found in the American-grown product. As a tanning material the tubers have been found very satisfactory, the tannage progressing rapidly and producing a soft, bright yellow leather of considerable weight and firmness. It is specially suitable for use in re-tanning and finishing light goods and harness. The softening effect in the tannage is very similar to that of gambier or sumach. There is no doubt that if regular consignments of the tubers were available, the material would be readily adopted by tanners, who have spoken very favourably of its properties. In countries where hand labour is cheap, cultivation might prove profitable, and the fact that the crop can be produced within two years of planting is a feature that makes canaigre worthy of consideration for further trials.

## **THE SECOND (TRIENNIAL) MINING AND METALLURGICAL CONGRESS**

**WITH SOME ACCOUNT OF THE MINING AND POWER DEVELOPMENTS IN THE PROVINCES OF ONTARIO AND QUEBEC.**

**BY SIR RICHARD REDMAYNE, K.C.B., M.I.C.E., F.G.S.**

### **I. THE CONGRESS**

IN August 1927 I accompanied the Director of the Imperial Institute to Canada as the representative of the Institute at the Mining and Metallurgical Congress which was to be held in the Dominion during August and September. The first Congress was held in Great Britain and the third will be held in South Africa in the year 1930.

During the Congress a number of meetings were held at which synopses of papers on mining and metallurgy and subjects immediately allied thereto were read. Owing to the extent of the ground covered there was not much time for serious discussion, and probably at future congresses it would be well if the papers were restricted to descriptions of the mines, works, and geology of the places visited, for an important part of the programme on these occasions is that devoted to visits of inspection. On the occasion of the Canadian visit the programme in this respect was varied, and splendidly organised by our Canadian hosts.

Another advantage of such a gathering as that under consideration, and one of peculiar value to the Imperial Institute, is that resulting from the interchange of ideas of men congregating from all parts of the Empire and concerned in the furtherance of similar objects. On the occasion of this visit, one not only met many Canadian mining engineers, metallurgists, and geologists—as well as heads of Government mining, geological, and statistical Departments—but also delegates from other Dominions and Colonies, as well as some foreigners, under such auspices as led to the establishment of pleasant relations and conduced to a free and frank exchange of views. One was enabled to understand the Dominion point of view



from observations made on the spot, to comprehend the difficulties to be surmounted, and the wants to be met, and to ascertain in what directions the Mineral Section of the Imperial Institute can be made of greater use.

One found on all sides great interest in the aims and objects of the Institute, and a desire to exchange information and to take advantage of what may be termed its "post office" facilities in its capacity as a clearing house of technical information.

The Congress, from the point of view of inspection, was divided into two parties, namely "A" tour and "B" tour, which held together as far as Cochrane when they bifurcated, the one, "A," proceeding to the west, and the other, "B," to the east.

The Congress was opened at Montreal, sessional meetings being held at that town, at Ottawa, Toronto, Winnipeg, Vancouver, Edmonton, Quebec, Sydney (Nova Scotia) and St. John's (Newfoundland).

The following resolution was discussed at two of the sessional meetings held at Montreal, and unanimously adopted :

"That this the Second (Triennial) Empire Mining and Metallurgical Congress assembled in Canada, having discussed a proposal for instituting a review of the mineral resources and industries in each administrative unit throughout the Empire, and of the conditions affecting their development, embodied in a paper submitted under the auspices of the Institution of Mining and Metallurgy by Sir Thomas H. Holland :

*"Resolves—*

"That the proposal be referred to the Empire Council of Mining and Metallurgical Institutions, to be transmitted to the Councils of the constituent bodies for consideration, with a request that they will formulate their views and communicate them to the Empire Council for further action."

It now remains to be seen what will be the outcome of the deliberations of the constituent bodies.

Some years ago the present writer expressed himself as follows on this subject :

" When the late President Roosevelt was in office he was impressed with the advisability of the world taking stock of its mineral resources and conceived the idea of a World Congress to draw up an inventory, as it were, of its resources in raw materials and power. Such a Congress never came into being. The United States has, I believe, worked out a fairly elaborate estimate of its resources in forests, minerals and water power. . . . The time would appear ripe for that confederation of nations—the British Empire—to take stock of its resources, for the purpose of inter-Empire trade."

The World Power Congress, initiated by Mr. Dunlop, was held in London in 1924, the year of the great Exhibition at Wembley, and aimed at a somewhat similar object in regard to " Power resources of the world " as that suggested by President Roosevelt.

The present suggestion is restricted to a survey of the mineral and metallurgical resources and of the Empire industries connected therewith, with the objects briefly of " estimating the Imperial consequences of the conditions under which the mineral deposits are now being exploited as well as neglected." " There is no intention," we are informed (*Proposed Review of the Mineral Resources of the Empire*, by Sir Thomas H. Holland, p. 29), " to suggest by the word ' survey ' any elaborate enquiry into mineral resources. The Committees which are proposed for Great Britain and appropriate territorial units overseas should preferably be small bodies of independent specialists capable of forming, and of profitably re-forming, their general conclusions regarding the mineral situation, as metallurgical developments change the configuration of the international situation."

The work, if carried out to its logical conclusion, would undoubtedly be of great value. Some of it is being and has for long been covered by the activities of the Imperial Institute, which are always available in the interests of the Empire. The chief difficulty will be to obtain reliable and authoritative statistics in regard to *consumption* and *values*, as to which the particulars at

present available, in most countries, are of a purely voluntary character.

One cannot conclude this part of the article without an expression of appreciation of and thanks for the great courtesy, hospitality and kindness of which we were the recipients from their Excellencies the Governor-General and Lady Willingdon, members of the Government, Government officials, university professors, the owners of mines and works, and the officials of the great railways.

## II. MINING, METALLURGICAL AND POWER DEVELOPMENTS IN THE PROVINCES OF ONTARIO AND QUEBEC

The present writer had not the advantage of proceeding further west than the township of Cochrane, so his account of the inspection of works is limited to that part of eastern Canada which is covered by the Provinces of Ontario and Quebec, where he visited :

1. The works of the Steel Company of Canada at *Hamilton*.
2. The falls of *Niagara*.
3. The refinery of the International Nickel Company of Canada at *Port Colborne*.
4. The *Welland Canal*, in course of being widened and otherwise improved.
5. The Creighton Mine (nickel, etc.) and smelter of the International Nickel Company of Canada at *Sudbury*, and the Garson Mine of the Mond Nickel Company.
6. The Keeley Silver Mine and the Taylor Hydraulic Air Compressor near *Cobalt*.
7. The Lake Shore and other gold mines of the *Kirkland Lake field*.
8. The Dome and other mines of the *Porcupine* district.
9. The Noranda Copper Mine and Smelting Works at *Rouyn*.
10. The hydro-electric power works of *Isle Maligne* and the neighbourhood of *Arvida*.

The route followed and the places visited are indicated in the accompanying sketch map (facing page 60).

*The Steel Company of Canada*

The steel works are situated on the outskirts of the town of Hamilton and consist of blast furnaces and steel mills. Hamilton, which is the third largest manufacturing centre in the Dominion with a population of 125,000 and about 700 factories, is situated on Burlington Bay, at the western extremity of Lake Ontario. This bay is a beautiful sheet of water about four miles long by three wide. The Steel Company of Canada is a fairly young concern, having been incorporated only in 1910 to take over the assets of a number of separate companies in various parts of Ontario and Quebec. Whilst it operates in Hamilton, it controls subsidiary plants in London, Brantford, Toronto, Belleville, Gananoque and Montreal, all in Canada.

The iron ore is conveyed from the Lake Superior mines to Hamilton, the coal from the United States, and the fluxing limestone from local sources. There are two blast furnaces producing annually 290,000 tons of basic, foundry, and malleable pig-iron. There is a coking plant with a capacity of 365,000 tons of coke which is produced from a battery of 80 Wilputte by-product recovery ovens. There is also a benzol recovery plant in connection therewith, capable of producing 2,190,000 gallons of light oil per annum, and of course the ammonia is also recovered as sulphate.

The steel plant comprises 11 basic open-hearth furnaces and one 100-ton mixer. The fuels used in the open-hearth are gas and tar, from the coke ovens, and producer gas from six Morgan producers. The capacity of the steel plant is 300,000 tons of ingots per annum.

The modern type rolling mill has a capacity of 260,000 tons of blooms, billets, and sheet bars per annum, and there are sheet mills, cold mills, an annealing furnace, and spike shop (for railway spikes). Of hot-rolled products, including wire rods, merchant bars, light structural shapes, agricultural implement shapes and similar stocks, the output capacity is 150,000 tons per annum.

At the other works other steel products are turned out.

The other Iron and Steel works in the Dominion is that belonging to the Algoma Steel Corporation, situate

at Sault Ste. Marie on Lake Superior, which was not visited ; they have an annual capacity of 500,000 tons of various grades of pig-iron, with coking and steel plants.

*The Water Power Resources of the Dominion  
Niagara and the Saguenay*

The falls of Niagara are too well known to require description here. Besides providing a scene of beauty and wonderment to the many thousand sightseers who annually visit them, they are a source of great power, actual and potential : in fact, they are the greatest example of the electrical utilisation of water power in the world, and yet it is only since October 1890 that their harnessing was inaugurated.

The power of the Niagara river, which is shared with the United States, in its total descent (it is 37 miles long and drops 325½ ft. in that distance, the height of the falls being 165 ft.) would yield from five to six million horsepower, but by international treaty Canada is restricted to a total division of 36,000 and the United States to 20,000 cubic feet of water per second, and these quantities are practically all now in use.

The growth in the hydro-electric generation of power in Canada is one of the most remarkable features of her recent industrial development.

In 1900 the total installation amounted to 170,000 h.p. ; by the end of the year (1927) this was expected to reach the impressive figure of 4,883,000 h.p. and the potential resources are vast. As illustrating the vastness of the supply of energy from individual power stations the case may be quoted of Isle Maligne, and the station in course of construction nearby, at Chute-à-Caron, both in the Province of Quebec (see Fig. 3). These are on the Saguenay River, where from Lake St. John to Chicoutimi there is a descent of 300 ft. Both of these were visited by the writer. The Isle Maligne station is at the upper of the two sites, where there is a maximum head of 123 ft. and a minimum of 96 ft., or a difference as between summer and winter of 27 ft. The head is made full use of and there are 12 units each generating 30,000 h.p., or a total of 360,000 h.p.

The Chute-à-Caron station is, as stated, under construction. The two plants will ultimately generate in the aggregate 1,340,000 h.p. The flow of the Saguenay is regulated by storage in Lake St. John, controlled by the works at Isle Maligne. The power is transmitted to pulp and paper mills in the district, to the newly established aluminium works at Arvida, and part is purchased by the Shawinigan Water and Power Company and delivered over a long-distance transmission line to the city of Quebec and district.

*The Welland Ship Canal* is an artificial waterway of great interest and importance. It connects Lake Erie with Lake Ontario. The first canal was commenced as far back as 1824, and was equipped with 40 wooden locks, each 110 ft. long. In 1845 and 1882 it was extensively altered, and is now again being enlarged and improved at an estimated cost of £24,000,000, of which about £10,000,000 has already been expended. The difference of level between the two lakes, amounting to 325½ ft., will be met by a series of 7 lift-locks each 800 ft. long and the width of 80 ft., the depth over the lock sills being 30 ft. The length of the canal will, when completed, be 25 miles instead of, as at present, 27½ miles, the entrance from Lake Ontario being at Port Weller instead of, as heretofore, at Port Dalhousie.

It is estimated that fully-loaded freight vessels will pass through the canal in 8 instead of, as heretofore, 15 to 18 hours, and several vessels can be locked through at one time.

### *The Nickel Mines and Metallurgical Works*

The importance of the nickel mining industry to Canada will be realised when it is stated that of the 33,400 tons world production in the year 1926, Canada contributed no less than 29,339 tons. But beside nickel the ore mined in the Sudbury district contains copper and precious metals, particularly those of the platinum group, the recovery of which on a commercial scale was first effected by the Mond Nickel Company. The ores on the average run not over 3 or 4 per cent. nickel and the copper in smaller proportions. The proportion of copper to nickel in the blast furnace matte is roughly 4 to 7; the precious

metals recovered are gold, silver, platinum, palladium, rhodium, ruthenium, iridium and osmium. The resources of ore are vast, the Royal Ontario Nickel Commission in 1916 concluding that on a conservative basis there were proved 70,000,000 tons, and that the proved, probable and possible ore together exceeded 150,000,000 tons. The average metal content of the ore mined from open-cuts at the Frood Mine of the International Nickel Corporation was 2.03 per cent. nickel and 1.45 per cent. copper.

The companies chiefly engaged in working and treating the ores of Sudbury are the International Nickel Company and the Mond Nickel Company, who together supply 90 per cent. of the world's demand for nickel. The nickel district covers an area of 550 square miles.

The nickel-copper area is occupied by Pre-Cambrian rocks, and the geology of the Sudbury district is most interesting and rather complex. "The rocks that are regarded as most important from an economic point of view, because of their probable genetic relation to the ore deposits, and that have attracted most attention because of their scientific interest, are those that make up the Sudbury norite-micropegmatite sill. The sill outcrops in a band in the form of an ellipse, with a major axis of 36 miles and a minor axis of 16 miles. The average width of the southern part of the band is 3.1 miles and of the northern part 1.9 miles, and the total average width is 2.5 miles. The outer edge of this elliptical band of igneous rocks is basic; the inner edge acidic." (See *Canada*, by Wyatt Malcolm and A. H. A. Robinson, printed at Government Printing Bureau, Ottawa, 1927, page 72, to which the reader is referred for an excellent and clear statement of the geology of this district.)

The dip of the outer edge of the norite is generally inwards towards the centre of the ellipse. The basin surrounded by the norite and granite ridge is flat and in it are sandstones, conglomerates and other sedimentary rocks in a syncline.

A visit was paid to the Creighton Mine of the International Nickel Company, from which all the ore now being treated by that Company is derived. It is the largest nickel mine in the world. The ore at this mine

occurs in lenses, in parts inspected by the writer 150 ft. thick, and the ore values appear to increase in depth. The mine was splendidly equipped, the ore being hauled underground by electric storage battery locomotives to the ore-pass and underground crushers at the loading stations, from whence the crushed ore is wound up the shaft—18 ft. by 24 ft. with 4 skiptracks—to the surface, where it is sorted, about 15 per cent. being waste rock. The remainder, about 60 per cent. of which is large and 40 per cent. fines, is passed to the roasters 6 miles away, at the Smelting Works at Copper Cliff, which we also inspected. The ore is roasted or calcined without a flux to bring it up to 10 per cent. metal value; thence the fines, which would choke a blast furnace, are carried to the reverbatory furnaces, which brings them up to 18 per cent., the only flux used being a little sand. Sometimes the reverbatories are heated by crushed coal (crushed, dried and then fine-crushed). The large is passed to blast furnaces using coke, usually no flux being added, the iron in the ore being sufficient for the purpose, though sometimes a little limestone is used. The product from the furnaces is transported to the basic converters for enrichment. Here it is melted and air blown in for 20 minutes. When it leaves the converters the matte contains 30 per cent. nickel, and 20 per cent. copper. The matte, in the case of the International Nickel Company, is conveyed to the refinery works at Port Colborne, where it is treated for the separation and refining of the nickel in three major operations, viz. (a) smelting with suitable fluxes to effect primary separation of the nickel from the copper; (b) calcining and leaching the nickel-containing product; (c) reduction of nickel oxide and casting the resulting metal. Besides which there is an electrolytic refinery where nickel 99.9 per cent. metal is produced. The "flow sheet" of the treatment at the refinery is given on p. 48.

The method of working the thick ore-body at the Lavack Mine (Mond Nickel Company), and the electrolytic method of refining impure nickel at the International Nickel Company's refinery present points of very great interest to the technologist, which the exigencies of space prohibit being dealt with here.



A quite recent innovation in regard to the use to which nickel may be put is in its inclusion in cast iron,

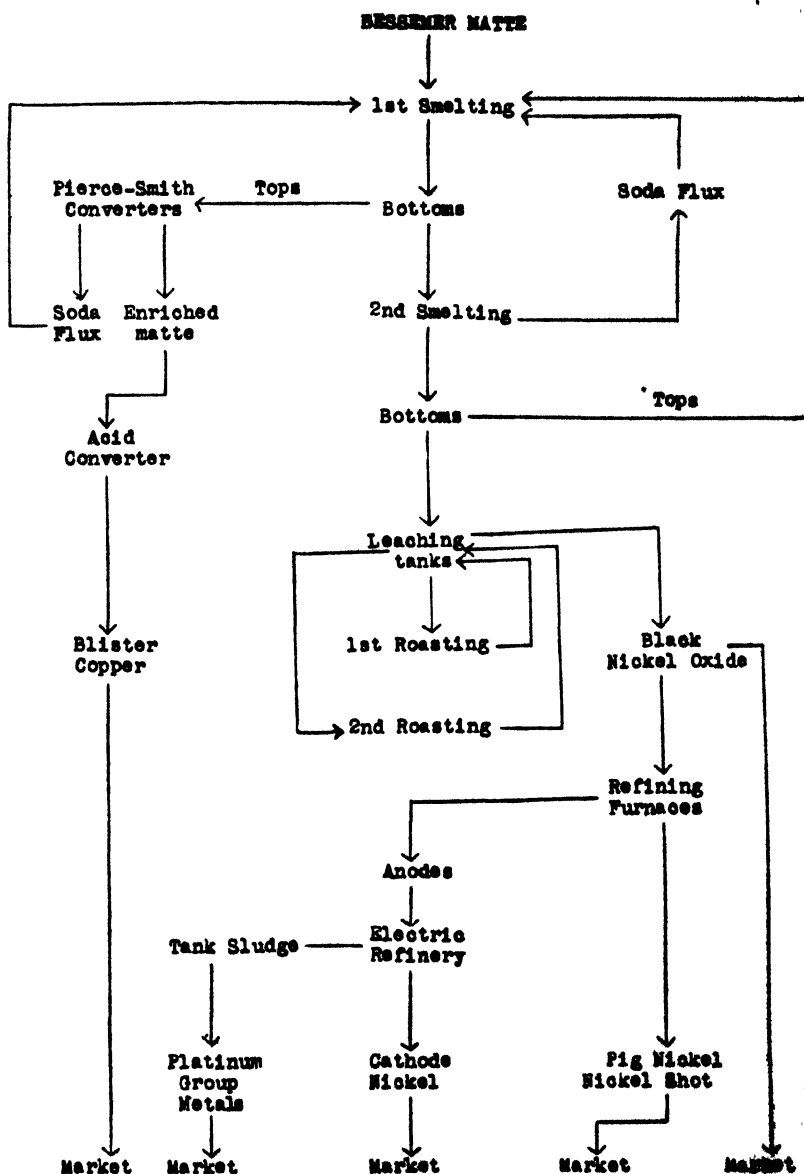


FIG. I.—Flow Sheet.

where it is of great value especially in the case of internal combustion engine cylinders; it is thought its useful

action lies in segregating the carbon and so giving greater resistance to the cast iron. The melting point of nickel is higher than that of iron, but can be reduced by the addition of silicon, so allowing of the thorough mixing of the iron and nickel in the molten state.

The value of nickel steel is well known—as the Minister of Mines for Ontario remarked in a recent address on the occasion of the Diamond Jubilee of the Royal Ontario Institute, November 12, 1927: “Wherever strength combined with reduced weight is a desideratum, nickel-steel is indispensable.”

### *Silver Mining*

*The Cobalt District.*—The Dominion is a great producer of silver. Out of a total of 39,600,000 ounces, the production in 1926 for the British Empire, 22,371,924 ounces were contributed by Canada, or over 55 per cent.—about 9 per cent. of the world's output of 250 million ounces.

About half of the silver produced in Canada is derived from mines in Ontario, and about half of this again is the output of mines in the Cobalt Camp, the output from which totalled, in 1926, 4,797,832 ounces. The discovery of silver ore at Long Lake (near the west shore of Lake Timiskaming), subsequently re-named Cobalt Lake, 330 miles north of Toronto, was made in 1903 during the construction of the Timiskaming and Northern Ontario Railway from North Bay to the head of Lake Timiskaming for the purpose of tapping timber areas and serving small farming communities (see *Ontario's Mines and Mineral Resources*, issued by the Ontario Department of Mines, Toronto, Canada). The silver occurs not only along with niccolite and other arsenides of nickel and cobalt, but as native silver in lumps and plates. Strange as it may appear, it was some time before the public realised the immense potentialities and value of the field, that it, in fact, constituted one of the world's richest silver camps. In 1911 the maximum output was reached with 31,507,791 fine ounces.

The silver occurs in the Nipissing diabase, the youngest member of the Pre-Cambrian group of rocks. This intrusion exists in the form of a sill of variable thickness

and undulating over a wide area into the older members of the Pre-Cambrian. "The diabase is found in contact with the several other members of the Pre-Cambrian, the oldest of which is the Keewatin, a complex series consisting essentially of volcanic types now represented by schists and greenstones. Unconformably on the Keewatin lies the Timiskamian series, a group of fragmental rocks of sedimentary origin, of which there are several bands in north-eastern Ontario, extending in a general east-west direction. Succeeding the Timiskamian is a group of igneous rocks known as the Algoman. This widespread series, consisting of granite, porphyries and certain basic facies, is responsible for the gold ores of Ontario. Next comes the Cobalt series . . . consisting of conglomerate, greywacké and quartzite, in which a great number of productive silver mines have been found adjacent to the Nipissing diabase. The diabase, considered to be the source of the ores, followed the Cobalt series and is believed to belong to the Keweenawan." (*Ontario's Mines and Mineral Resources*, p. 39).

The Cobalt silver district includes the Cobalt area proper of about five square miles, and also a stretch of country about 70 miles in length.

An interesting comparison between the production of the precious metal from the great silver mining camps of the world has been instituted by Messrs. Malcolm and Robinson in their work previously referred to which may be reproduced :

District.	Silver production in metric tons.	Years.
Potosi, Bolivia .	over 30,000	Since 1545
Guanajuato, Mexico ..	15,000	" 1558
Zacatecas, Mexico .	14,000	1548-1832
Cobalt, Canada .	11,358	1904-1923
Freiberg, Germany .	5,243	1163-1896
Comstock, Nevada .	4,820	1859-1889
Pachuca, Mexico .	3,500	1522-1901

The mine visited by the writer was the Keeley Silver Mine, the property consisting of about 80 acres in the South Lorrain district, and situate about eighteen miles south-east of the town of Cobalt, in which district a good deal of British capital is invested. The Keeley mine, which was discovered in 1907, was taken up by Mr. J.

Mackintosh Bell on behalf of English interests in 1913, but it was not until 1919 that production really got under way, the total production up to March 1, 1927, being over eight million ounces and £400,000 has been paid in dividends.

The ore occurs in both the Keewatin greenstones and the diabase. The deepest workings are 895 ft. below the collar of the shaft. The high-grade ore is bagged as far as possible underground and is also picked out at the surface, the remaining ore treated being crushed by stamps, the pulp passing over tables, and the tailings submitted to oil flotation. The high-grade ore, which averages 4,000 ounces to the ton, and the concentrates, are shipped to the Deloro Smelting and Refining Company at Deloro, Ontario.

The silver area is called "Cobalt" from the fact that the silver ores carried the metal of that name as one of the constituents.

#### *Air Compressing Plant*

A very interesting method of air compression for service at the mines of this district was inspected in the neighbourhood at Ragged Chutes. This is the Taylor Hydraulic Air Compressor Plant of the Northern Ontario Light and Power Company. It is situated on the Montreal river, 8 miles south of Cobalt. It is practically automatic, the compression of the air being effected by the action of falling water trapping the air particles in its descent, the air being afterwards liberated in a confined chamber and compressed. Though the compression of air by means of water is not new, the method adopted by Mr. C. H. Taylor of Toronto and carried out here is an elaboration of previous applications consisting, as it does, of breaking up the water and impregnating it with finely divided particles of air. The rough sketch on p. 52 will explain how the compression is carried out :

The capacity of the compressor is 5,500 h.p. under a 50-ft. head and it is probably the largest *natural* air compressor in the world. The dam which stretches across the river is 660 ft. long. There are 2 intake shafts 16 ft. in diameter, each fitted with 66 air intake pipes 14 in. in diameter. These heads are maintained at a height which

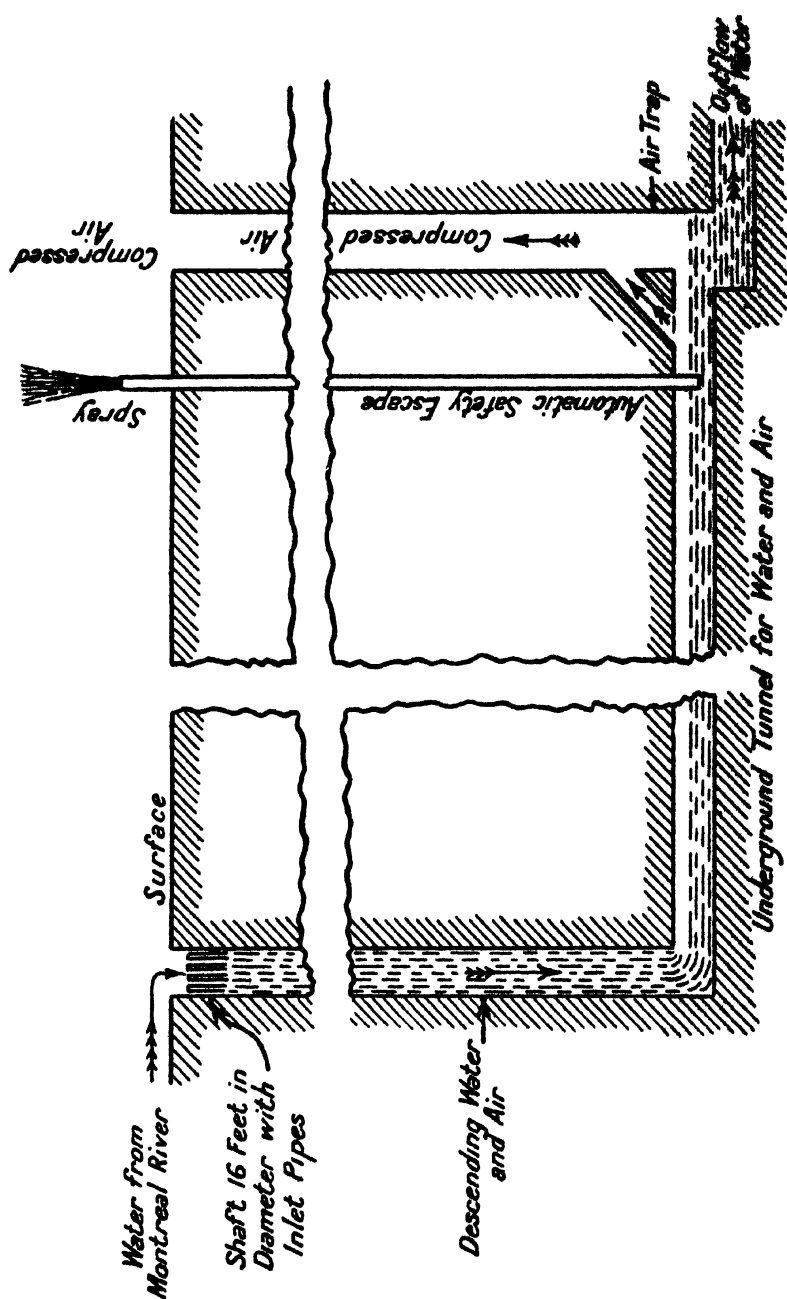


FIG. 2.—Air-Compressing Plant.

slightly submerges the tops of the smaller intake pipes by means of vertical pneumatic lifts operated by compressed air piped from the air mains. The falling water draws the air in through the small pipes and thus in its descent of 350 ft. becomes a mixture of water and compressed air. The water intakes are reduced to 8 ft. 6 in. diameter immediately below the spider and 40 ft. from the bottom the diameter is increased to  $11\frac{1}{2}$  ft., in order to lessen the velocity and to liberate the air. The full impact of the water is received by two steel-sheathed concrete cones, which direct the flow into the tunnel which is 1,021 ft. in length, 22 ft. wide, and at the bottom of the intake,  $26\frac{1}{2}$  ft. high, but at the foot of the tail shaft, 42 ft. high. A 24-in. steel pipe conducts the air to the surface into a 20-in. main. It will be realised that the upper part of the tunnel acts as an air receiver and reservoir. The water passes out to the river again through a discharge shaft at a point 48 ft. lower than the collar of the intake shaft. In the tunnel the air is compressed, isothermally of course, to 125 lb. per square inch.

### *Gold Mining Camps*

*The Kirkland Lake and Porcupine Fields.*—The geological formation in which the gold of Ontario occurs has been alluded to briefly under the heading of silver. The first gold mining camp we visited was that of Kirkland Lake situated in Teck township, 63 miles north of Cobalt, and 382 miles from Toronto by rail. At Kirkland Lake the main ore zone has been traced for a distance of  $2\frac{1}{2}$  miles ; and the mines, proceeding from west to east, are the Macassa (non-producing), Kirkland Lake, Teck-Hughes, Lake Shore, Wright-Hargreaves, Sylvanite and Tough Oakes Bromside.

Gold was only discovered in this field in 1911. Teck-Hughes has been sunk to a depth of 2,300 ft. The Kirkland Lake presents the interesting case of a mine which only won the gold after going 2,000 ft. through rock ; the success of the undertaking being due to the sagacity, scientific knowledge and courage of the managing director, Mr. J. B. Tyrrell, who in 1924, when he took over the management, pinned his faith on striking the main Kirk-

land Lake orebody at the depth he contemplated, a depth which astonished the mining imagination at that time. And now the programme of reaching a depth of 3,500 ft. is within the possibilities of the ensuing year of 1928.

At the 2,600 ft. level the vein is rich and wide.

The Teck-Hughes, Lake Shore and Wright-Hargreaves are well-known producing mines.

At Teck-Hughes the four compartment shaft is down to a depth of 2,250 ft. ; the main shaft of the Lake Shore to 1,600 ft. Development on the two main veins which pass from Lake Shore into Wright-Hargreaves area has been carried out on the latter property from a shaft on each vein to a depth of 1,500 ft.

The total production from the camp up to March 31, 1927, amounted to £5,520,125, and during the first quarter of 1927 the recovery per ton from the three principal producers was as follows :

Lake Shore . . . . .	£2·64 (\$13·21)
Wright-Hargreaves . . . . .	£2·22 (\$11·12)
Teck-Hughes . . . . .	£3·44 (\$17·19)

The Algomian intrusions, alluded to when describing the geology of the Cobalt area, are the chief gold bearers at Kirkland Lake.

" The gold-bearing solutions responsible for the deposition of the ores are considered to be genetically connected with the felspar porphyry, the intrusion of which was the last important phase of igneous activity prior to the formation of the vein structures. . . . The gold associated with sulphides, tellurides, graphite, carbonates and dark-coloured quartz occurs in fractures in an earlier generation of milky quartz and also filling minute openings in shattered wall rock. The most abundant sulphide is pyrite, while chalcopyrite is present as a rule where the values are appreciable . . . the presence of any telluride in the ore is an indication of high values." (From a Pamphlet prepared for the members of the Congress.)

The gold ores of this camp are much richer than those of Porcupine, which was the next place visited by us. Quoting again from the address delivered by the Hon. C. McCrear, the Minister of Mines for Ontario, " the first impressions of this field (Kirkland Lake) were that the

mines would be small. Events have proved this opinion erroneous, and as the field developed it was seen that the lower levels in the mines not only fully maintained the surface values, but contained very large reserves of ore. The Kirkland Lake production is growing very rapidly and its nine mines now provide about one third of the entire gold output of the Province."

The milling practice at this camp is that known as "all-sliming" cyanidation, which means that the ore is reduced by coarse crushing, and then grinding in rolls and ball mills to a very fine state of division, and subjected to the action of a solution of cyanide to extract the gold. No stamps are employed and no amalgamation with mercury.

*The Porcupine Field.*—This field, of which the chief town is Timmins, named after a prominent mine owner, dates from 1908. The richness of Cobalt attracted large numbers of prospectors from all over the world who eventually extended their work of exploration far beyond the silver region, Government geologists having interpreted the geological formation in certain parts as possible sources of gold. This led to the staking of claims on the Porcupine River. On a glaciated slope the quartz was found (in 1909) to contain natural gold in profusion. The prospectors termed this the "golden stairway" and here the Dome mine was sunk and opened out. Not far distant from this mine are the world-famous Hollinger and McIntyre mines, named after the prospectors Benny Hollinger and Sandy McIntyre respectively. The former mine is the second largest producer of gold of the individual gold mines of the world.

From 1909 to 1925—the first sixteen years of its existence as a mining field—Porcupine has produced about £32,269,200 of gold and paid in dividends about £8,988,800. There are eight producing gold mines in the camp and in 1925 the production was 1,196,199 fine ounces of gold from six of these mines, thus :

	Fine ounces.
Hollinger . . . . .	757,306
Dome	210,051
McIntyre . . . . .	178,556
Vipond Consolidated . .	27,244
Consolidated West Dome Lake	13,582
Night Hawk Peninsular .	9,460



The mills of the other two producers, the Ankerite and the Paymaster, were not in operation until 1926. The ore, which is mostly dark grey, is quartz and mineralised schist, iron pyrites being the chief mineral accompanying the gold. The schist in the Hollinger-McIntyre area is highly altered volcanic rock, ranging from basalt to dacite of Keewatin age. At the Dome mine, the most productive rock was a schistose conglomerate and greywacke of Timiskaming age.

At Dome the strata are very much contorted. The ore lenses, which dip north and pitch north-east, are sometimes in syenite and sometimes in the conglomerate. Porphyry is the latest rock, though of pre-Cambrian age, and it is considered to be the medium, the agency, which led to the mineralisation of the conglomerate.

The geology of the district is extremely complex and difficult to fully understand. The more credit is, therefore, due to the very highly skilled Canadian geologists who have unravelled it. The quartz is very irregular, sometimes occurring in broad lenses with fragments of schist and sometimes as narrow veinlets cutting the schist at any angle. The quartz is milky white. Definite vein formation, as commonly interpreted, there is not, but mineralised zones, which are most intense along the fracture planes in the quartz,—at least that is how the structure impressed the present writer.

The altitude of the mines is from 1,000 to 1,100 ft. above sea level, and they are attaining to considerable depth. Thus it is intended to sink the No. 11 shaft at the McIntyre mine to 4,150 ft.—already they are driving on the veins at the 2,875 ft. level. At the Hollinger the central shaft is down 2,400 ft. and it will be sunk to 3,000 ft. Winzes at this mine have reached depths of 2,750 and 3,200 ft.

The milling of the ore may be divided into four stages, viz.:

(1) Reduction of the ore to such a fineness as will expose the metal to the action of extracting solutions.

(2) Dissolving of the gold with sodium cyanide solution.

(3) Separation of solution containing values from the solids and elimination of these solids or tailings.

(4) The recovery of the gold from the solution by precipitation, and the refining of the precipitate.

At the Hollinger the first reduction is through a 48-in. by 60-in. crusher at the 2,150 ft. level, which reduces to 7-in. size lumps. Thence successively through gyratory crushers, rolls, rod mills and tube mills until it is reduced in size so that 65 per cent. will pass through a 200-mesh screen. As the rock goes to the rod mills a solution containing  $\frac{1}{2}$  of a pound of cyanide to the ton is added. This solution starts immediately to dissolve the gold and silver from the rock, and continues to do so through the subsequent grinding operations. In order to complete the solution the mixed ore and solution are agitated with air for sixteen hours, after which practically all the gold is extracted. However, the pyrite of the ore contains gold not so easily given up, so the ore is concentrated, this pyrite separated, ground much finer and further treated to extract these more difficult "values."

After the dissolving action, the separation of solution from tailing is accomplished in one or two ways.

(1) The mixture is passed through a counter current decantation plant, where the gold in the solution accompanying the tailing is successively reduced through three tanks. This pulp is then filtered and washed to remove the remaining gold.

(2) The pulp is filtered and washed on two successive filters which accomplishes the same result as above.

Having the gold and silver in solution a small amount of zinc dust is added to the solution. This zinc dust throws the gold and silver out of solution as a fine powder or precipitate.

This precipitate is filtered out of the solution and sent to the refinery.

At the refinery it is boiled with hydrochloric and then sulphuric acid, the final result being four separate products—gold of over 99 per cent. fineness, silver, some copper and some lead.

Again quoting from the Minister of Mines for Ontario,

"The distinguishing feature of gold mining in Ontario is the wide distribution of the deposits. The gold is not confined, as in the Transvaal, to one district, but is found in many places from the Quebec boundary to Manitoba. For instance, at Condreau, on Lake of the Woods, at Red Lake, Wornau Lake, and other places."

"At the Howey mine, Red Lake, one of the mineral fields," writes Mr. Thomas Gibson, the Deputy Minister of Mines for Ontario, to me under date November 15, 1927, "a shaft has been sunk 525 ft., and cross-cuts driven to the ore at several levels. They report first-class results."

Unfortunately, time did not permit of the present writer visiting these places, even had they been included in the Congress itinerary. But perhaps enough has been said to demonstrate the vastness of Canada's potentialities in the matter of gold.

The gold production of the world in 1926, as far as the figures are available, was 19,500,000 fine troy ounces. In reality it was probably over 20 million ounces. Of this the British Empire accounted for 13,600,000 ounces. The order of production of the chief producers in the world was as follows :

	Ounces.
The Union of South Africa . . . . .	9,954,762
The United States of America . . . . .	2,238,616
Canada . . . . .	1,754,228

The probability is that in 1928 Canada's output will surpass that of the United States and if so she will be second in the race.

*The Copper Mining Region of Rouyn.*—It was in the summer of 1920 that Mr. Horne staked out 400 acres of land on the shores of Lake Osisko, in the wilderness, south-east of Abitibi in the Province of Quebec, having observed the presence of sulphides there, across which he cut trenches and exposed a body of ore 60 ft. wide, carrying gold and a little copper. He increased the area of his holdings to 600 acres. More gold was discovered in 1922, and eventually all the Rouyn township of 10 square miles was staked, as well as a large portion of the surrounding country. Towards the end of August 1923 a bore hole

was put down at Noranda, the core of which, 11 ft. from the surface and for a depth of 131 ft., was solid sulphides averaging 8.23 per cent. copper, with a gold value of about 17s. 6d. per ton. Now there is opening out an extensive mine, and adjacent to it, nearly completed—it will be turning out blister in a few weeks—is a magnificent, most complete and up-to-date smelting works, where the ore will be treated.

The formation of the Horne area is of pre-Huronian age, consisting of Keewatin volcanic rocks, comprising rhyolite lavas and agglomerates, together with basic flows of andesite. This formation is pierced by intrusive dykes of gabbro or diorite, later gabbro and syenite-porphyry. The dykes are, therefore, of three types and ages. All the valuable ore-bodies have so far been found in the andesites. In the rhyolites there is mineralisation varying from scattered grains to wide veins of massive sulphide, but this sulphide is practically pure pyrite, carrying no copper and only low values in gold. The ore bodies in the andesites consist of lenses or lenticular masses, of almost solid pyrrhotite, pyrite, or chalcopyrite. At No. 1 shaft, five separate lenses of ore occur flanking the dyke of newer diabase-traversing the property north and south. These lenses strike north-east and have a steep dip; when in contact with the dyke the higher is the grade of the ore, which points to the probability of the dyke having been the carrying medium of the copper. Zinc also occurs in connection with the copper. According to the last annual report of the company, the indicated ore reserves as on January 1, 1927, above the 300 ft. level, the lowest horizon of the mine at present, were 1,022,425 tons, having a gross value of \$25,100,000, taking copper at 13 cents per pound. No zinc ore was included in the above estimate. The average grade of the copper ore is approximately \$5.03 gold and 7.51 per cent. copper. Drill holes have been put down proving good ore to exist at 450 and 740 ft. vertical, so it would appear that a great future lies before this undertaking and that the expenditure involved in the erection of the fine smelter is well warranted.

Of copper the British Empire is woefully short, con-

tributing only 98,000 tons to the world's output of 1,510,000 tons. The United States produces over 779,000 tons, and controls outside her borders a very large production indeed. Her own production, plus what she controls, amounts to fully 60 per cent. of the world output. Canada is the chief copper-producing country in the British Commonwealth, with an output of 59,417 tons in 1926. It looks as if she, in the not far future, will vastly augment that figure.

In concluding these impressions of his visit to Canada—an all too short sojourn—the writer would like to acknowledge his indebtedness to Dr. Camsell (Deputy Minister of Mines, Ottawa), and Mr. Gibson (Deputy Minister of Mines for Ontario), and Mr. Eardley Wilmot, of the Canadian Mines Department, and all his other Canadian friends, for the information with which they have so freely supplied him.

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## NOTES ON COAL MINING IN CANADA

By D. H. CURRER BRIGGS, J.P., M.A. (Oxon.), M.I.M.E.,  
A.M.I.C.E.

No one, from whatever angle he may regard matters of Imperial development, can fail to appreciate the usefulness of the visit of the Empire Mining and Metallurgical Congress to Canada in 1927, or in fact visits of any similar congress to any of the Dominions.

This visit afforded an opportunity to men, trained in the various branches of mining throughout the Empire, to obtain complete and ample information on all aspects of the Canadian mining industry in all its various branches. To one particularly interested in the British coal mining industry, the visit was of the greatest significance. Canada holds some of the world's largest coal reserves, which are at present only at the beginning of their development, though the extent of these reserves has only been estimated as the result of geological investigation, and not from the direct proving of the various seams in the coalfields. The quantity involved is so large, that any alteration due





to actual proving would have little effect on the total computed. It is recorded that Dr. D. B. Dowling, in 1915, estimated the coal reserves of Canada as follows :—

	Millions of metric tons.
Nova Scotia . . . . .	9,719
New Brunswick . . . . .	151
Ontario . . . . .	25
Manitoba . . . . .	160
Saskatchewan . . . . .	59,812
Alberta . . . . .	1,072,627
British Columbia . . . . .	76,035
Yukon . . . . .	4,940
North-West Territories . . . . .	4,800
Arctic Islands . . . . .	6,000
Total. . . . .	<hr/> 1,234,269

Knowing that Canada owned large coalfields, and also that the United States, across the border, has had a reputation in this country for being up-to-date in mining methods, I was particularly anxious to find out if United States methods were being largely employed in Canada, and also how conditions there compared with those in this country, and for this reason the tour had an added interest.

In pursuance of our investigations we covered about 7,700 miles in Canada, exclusive of local journeys, and visited many mines (both metalliferous and coal mines), power stations, and other works.

None of the coalfields in Eastern Canada was visited owing to lack of time, but from inquiry it appears that these mines are worked much on the lines of British coal-mining practice. In the west Canadian fields, there are few highly developed modern coal mines, and the coal is of a much newer formation than that of the British coalfields, which have been highly developed.

In the equipment of the pits themselves, there was little of an impressive nature, except with regard to methods of underground transport and handling of coal between the face and the wagon on the surface, which had received closer attention. This may be due to the precarious character of the markets which have prevented extensive capital expenditure.



The Canadian market for coal produced within the Dominion has perhaps been hampered for several reasons, the chief of which appear to be (1) the unsuitable nature of the coal for metallurgical and particular domestic uses ; (2) the expense and difficulty of transport ; (3) the extended use of electric power produced in hydro-stations.

The extent of the Canadian market for coal can be judged from statistics for six months in 1927, compiled by S. J. Cook, Chief of the Mining, Metallurgical and Chemical Branch, Dominion Bureau of Statistics, Ottawa :—

*Exports of Coal for six months ending June, 1927*

Short tons.  
598,683

*Imports of Coal for six months ending June, 1927*

	Short tons.
Anthracite . . .	1,769,234
Bituminous . . .	7,804,775
Lignite . . .	4,670
Total . . .	9,578,679

A careful study of the bituminous coal consumption of Canada might well repay time spent on it by British coal-exporting collieries.

Dealing with these points more in detail, it appeared that a very large amount of the coal seams seen, being of a sub-bituminous character, contained high ash and moisture contents, but lacked good coking qualities. This coal was not wanted greatly in the raw state for treatment and use in other localities, because the coal was inclined to fall in transport, and also most of the coal required for domestic purposes would have to be suitable for consumption in enclosed stoves ; that is, of high carbon content. The only real and persistent market for the mines of western Canada seemed to be the two large railway companies, who could transport the coal themselves to their various depots, and arrange for stocks not to be held long enough to cause serious depreciation due to weathering.

Secondly, the distances to the more progressive indus-

trial and residential areas were so great that the railway rates placed the producers under a serious handicap, and made it possible for United States producers, who are in possession of better seams, to compete successfully with the Canadian product. In connection with the transport facilities available, it was quite clear that the United States was better equipped with the necessary type of rail cars for coal transport than was Canada, but this appears to be due to the fact that the premier industry of the middle-west is farming, and it has been necessary for the railway companies to provide transport for this type of traffic first, particularly grain, a condition which will unquestionably be remedied in the course of time in a country, developing as quickly as Canada, and one possessed of such progressive organisations as the C.P.R. and the C.N.R.

Thirdly, it was very noticeable that the greatest centres of industrial progress are not situated in, or adjacent to the coalfields as they are in Great Britain, but rather within easy reach of extensive hydro-electric developments to provide the necessary power, and good water communications to provide access for the materials of production. This is clearly borne out by the existence of such cities as Toronto and Hamilton, and, with the assistance of rail communication, the Sudbury area is showing great progress.

In support of the contention that the progress of development of Canada is largely dependent on hydro-electric power, some figures on the subject of quantity produced may be a matter of interest.

During the first six months of 1927, the electric power turbines of Canada generated energy for consumption in Canada at the rate of 31 million kilowatt hours daily. This compares with 28.6 million in 1926, 23 million in 1925, 21 million in 1924, and 19.6 million in 1923.

In connection with mining generally, the difference in the state of development of the metal-mining industry, as compared with that of coal mining, was very marked. The need for such metals as gold, silver, copper, zinc, and nickel, has acted as a stimulus towards the pursuit of progressive mining in these directions, with ample capital

facilities, and this work has been ably assisted by the skillful work of the electrical and civil engineer in providing the necessary power from the vast sources of water supply. There appeared to be no lack of capital to pursue satisfactory prospecting work and work of an experimental nature in manufacturing processes, and in several instances evidence was obtainable of quite large pilot plants having been put down at considerable cost to determine the best method by which to secure large-scale efficient production, after satisfactory ore-bodies had been discovered, before the full-sized surface plant or concentrator had been erected.

In some of the more permanent areas devoted to mining, it was interesting to note that such points as baths and change-houses had received a full measure of consideration, and examples of a very up-to-date nature were available for inspection, and in connection with this detail much interesting information could be obtained for the useful employment of the funds available through the miners' welfare movement in Great Britain.

With regard to the accommodation for employees, it seemed to be the general practice that the companies or corporations responsible for development of mineral areas undertook the necessary work in connection with housing, provision of meals and food, and facilities for recreation, until the area had become fully established with a prospective length of life, and then as other persons were attracted to the area, town sites were gradually developed. It was satisfactory to note in the settled areas that there was a strong inclination for people in all positions to own their own houses, frequently on the instalment plan, as soon as permanent prospects became sufficiently definite. Such a spirit indicates independence and self-reliance, which is sometimes found to be sadly lacking in the older countries.

The newer and more isolated mining camps exhibited a wonderful community spirit, and the inhabitants seemed imbued with perseverance, optimism and goodwill; while in general these camps seemed to be populated with contented people who were willing to work really hard at any work that offered.

Wages were high compared with Great Britain, the equivalent of £1 per shift of eight hours underground being quite ordinary, but the wage rates should only be compared after due consideration has been given to the comparative cost of living and other social amenities in Great Britain, such as cost of food, clothing, house rents, or cost of houses; and on balance, the Canadian will be found to be better off during his working life, but with less provision in case of accident, sickness, or old age. General education facilities are good, as are also the arrangements for higher education.

The Canadian mining industry has not as yet developed the safety and welfare side to anything like the extent that has taken place in this country, but more attention is obviously being paid to this now than has been the case in the past, by the various mines departments.

Interesting statistics were available throughout the tour on all subjects, which assisted in making a very interesting visit one of exceptional value. Government and provincial departments, banks, railway development branches, and operating companies, also did everything in their power to show the delegates every kindness and hospitality, and afford ample opportunities for increasing their knowledge with really accurate information on the progress of the industries of the Dominion.

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## THE MINING INDUSTRY IN NOVA SCOTIA

By Colonel the Honourable G. S. HARRINGTON,  
Minister of Public Works and Mines, Nova Scotia.

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NOVA SCOTIA is sharing in the rapid advance of the mining industry which is one of the remarkable features of Canada's recent progress. Production has forged ahead mainly in coal and gypsum, but there has been marked development in the mining of gold, salt, zinc, and other minerals.

Coal mining is one of the chief branches of industry in the province. Last year there were raised 6,640,000 tons, a large addition to the production of the previous year. The interesting fact about this is that over half

of it was won from submarine workings. There are two important land areas upon the mainland of Nova Scotia from which coal has been extracted for many years, and in one mine to a depth of 3,000 feet. The greatest reserves of coal are, however, on the shores of Cape Breton Island. In stating that the seams are on the shores a surprising truth is declared. The outcrops are actually on the beaches and only a comparatively small amount extends inland. In the most important area near Sydney, the coal seams present a frontage of thirty miles and dip regularly and evenly at slight angles under the Atlantic Ocean. Of course, there were comparatively large portions of the land area containing coal which have been worked by the ordinary methods and have been a valuable source of coal supply for many years. The future, however, lies under the sea, and the prospect is that this may become the most extensive theatre of submarine coal mining in the world.

Coal was discovered in the cliffs on the shore of Cape Breton by the early explorers and was mined to warm the garrison at Halifax in 1749 before the important bituminous deposits around Pittsburg were known at all. One would naturally suppose that Nova Scotia would have been able to build up a large trade in coal with the eastern part of the United States, but this has not been the case. The vast riches of that country in easily worked seams, the development there of efficient internal transportation, and import tariffs have prevented the Canadian coal from entering this market. Therefore, an effort has been made to send the coal as far westward into Canada as is economically possible. Ontario and Quebec are the richest and most populous parts of Canada, and if Nova Scotia could only supply them with fuel, the vexing question of production and sales would be quickly solved. However, the competition in this area arises from the cheap supply of bituminous coal from the Illinois and Ohio fields and anthracite slack from Pennsylvania. Aside from the few thin beds in New Brunswick, there is no coking coal in Canada between Nova Scotia and Alberta, a distance of about 2,500 miles. The new developments in coking practice, the wider use of powdered fuel for which

Nova Scotian coals are especially adapted, and the recent processes for producing oil from coal give a far greater importance to those deposits which are of the coking variety.

It was natural to expect that the first mining operations should be carried out on the land areas of the coal seams in Nova Scotia. These have been so extensive that most of the thick seams were worked out and the miners were forced to follow them under the sea. This working led to renewed confidence when it was found that the beds continued uninterruptedly without change in their quality and free from faulting. The silt on the sea bottom is of a kind that is favourable to submarine mining and there is plenty of rock cover to allow almost all the coal to be extracted. At the present time the working face of one mine is three and one-quarter miles from the shore. The experience of the operators during the last fifty years has brought them to a different attitude and they are now deliberately planning collieries for extension under the sea. During the last five years one shaft has been sunk in a cliff by the shore with the one idea of securing its output from beneath the sea. Its construction and equipment have been planned for a working life of 150 years.

There are numerous large deposits of gypsum distributed widely over Nova Scotia. A few only of these are not of the highest quality and purity. Some of them have been worked for many years, but recently there has been a great increase in the quarrying of this mineral. This is due solely to the many new uses it is finding in the modern building. New deposits have been opened up and the output has leaped ahead in an astonishing way. The production for the last year was 840,000 tons, which is more than a third greater than for the year before. Everything points to a larger tonnage next year. These deposits in Nova Scotia are by far the best and most extensive in the eastern part of North America and have a great future.

There has been a sharp revival in gold mining during the past year. The eastern half of the mainland of the province is one great area of gold-bearing rocks with associated volcanic intrusions. Gold was discovered about

1865 and for the next forty years a large number of successful mines were opened and worked. Then came a decline owing to increasing costs, the attraction of the new discoveries in Ontario and Quebec, and the persistence of outworn mining legislation which permitted the holding of areas without working them. New laws along the modern lines were passed recently and the effect was immediate. Individual enterprise came to life, and what was most encouraging, great mining and exploration corporations entered the field bringing with them capital, technical ability, and experience. A number of the old properties are now being satisfactorily developed with distinct promise of becoming successful mines. Not only have the new laws encouraged activity in gold mining, but they have led to the opening of both lead and zinc deposits by powerful interests.

A great deposit of rock salt has been gradually exploited during the last ten years. It has proved to be 400 feet wide and the depth and length are not yet known. The company feels that its workings have shown 60,000,000 tons of salt pure enough to sell directly after mining and crushing and 300,000,000 tons of a slightly lower grade. Lately the mine has been provided with a branch line of railway and a large wharf so that it may properly expand its production. A recent issue of bonds will furnish it with new mining equipment and an evaporating plant for making the finest grades of salt. The future for this project seems assured.

The mining revival in the last year has renewed the interest and confidence of the people of Nova Scotia and many capitalists outside. There is much more prospecting also on other deposits, which have been long known, of lead, tin, manganese, arsenic, scheelite, and rarer minerals. Coal mining is really the backbone and mainstay of the province because one-fifth of all the people are directly dependent on it and its sister, the steel industry. The market forecasts for coal are reassuring and the co-operation of the miners and their employers seems to be more secure than for any past period. Gypsum production will break all records during the coming year. Gold mining will supply an appreciable amount of bullion in

1928 and will probably surpass all of its activity of twenty-five years ago. No wonder that those concerned with mining predict a bright future in this industry.

## **PRESENT STATUS AND FUTURE POSSIBILITIES OF THE MINING INDUSTRY IN BRITISH COLUMBIA**

By VICTOR DOLMAGE, of the Geological Survey, Department of Mines, Canada.

THE mineral production of British Columbia has risen steadily, with only very minor recessions, from \$3,000,000 in 1892 to \$67,000,000 in 1926.<sup>1</sup> It is calculated<sup>2</sup> from returns to November 1st, and estimates for the remainder of the year, that the value of the production of 1927 will be about \$62,000,000, showing a decline of \$5,000,000. However, the value of the 1927 production calculated on the metal prices prevailing in 1926 would reach at least \$70,000,000, indicating a considerable increase in the quantity of minerals produced. From the production of 1926 a gross profit of 25 per cent. was realised and dividends actually paid amounted to nearly \$10,000,000, or 14 per cent. of the total production.

Of the \$67,000,000 worth of minerals produced in 1926, 26.5 per cent. was lead; 18.4 per cent. copper; 17.4 per cent. coal; 15.7 per cent. zinc; 9.9 per cent. silver; 6.7 per cent. gold; 4.9 per cent. structural materials; and 0.5 per cent. miscellaneous, including gypsum, fluorite, platinum, sodium carbonate, and pyrite saved from the ores of the Britannia mine by a process of selective flotation.

The estimated productions for 1927 of silver, lead, zinc and coal are greater, and copper and gold less than the respective amounts produced in 1926. The proportion of the total contributed by each of the above products in 1927, however, will not differ very greatly from the proportion which each contributed to the 1926 total.

<sup>1</sup> Ann. Rept. Minister of Mines, British Columbia, 1926.

<sup>2</sup> Figures obtained from J. D. Galloway, Prov. Mineralogist, Victoria, B.C.



The greater part of the metal comes from a comparatively few large mines, namely :—

	Daily capacity.
Sullivan : Lead-Zinc-Silver . . . . .	4,000 tons
Copper Mountain : Copper . . . . .	2,000
Britannia : Copper . . . . .	3,300
Hidden Creek : Copper . . . . .	4,000
Premier : Silver-Gold . . . . .	4,000

There are also a dozen or more smaller mines treating 50–200 tons a day and making regular shipments of concentrates or bullion. The majority of these are lead-zinc-silver mines situated in the south-eastern part of the province, but there are also four gold producers, the Nickel Plate at Hedley ; the Pioneer and Coronation in the Bridge River district and the Engineer at Atlin in the extreme north-west corner of the province. Besides these there are eight properties, the Whitewater, Ruth-Hope, Lucky Jim, Hewitt and Paradise in the south-eastern part of the province ; two in the Smithers-Hazelton district and one in the Alice Arm district on all of which concentrators are in various stages of erection, and will be put into operation early in 1928. A number of other mines such as the Sunlock, and Old Sport, copper mines on Vancouver Island, have large tonnages of ore developed and are ready to be equipped with concentrating plants, while a number of others such as the Monarch, Giant and Ruth Vermont of the Golden district, the Yankee Girl, Goodenough and Howard of the Nelson district, and the B.C. Silver of the Stewart district, have nearly, if not quite, reached a stage of development at which the installation of concentrators is warranted. There are thirty or more smaller, but in some cases highly profitable, mines which ship high-grade ore direct to smelters. Many of these are in the silver-lead district, but the more profitable are the Bell, Sally and Wellington of the Beaverdell camp situated in the Kettle River Valley east of the lower end of Okanagan Lake and the Porter-Idaho and Prosperity in the Portland Canal district. A large number of lead-zinc mines, most of them in the early development stage, ship milling-grade ore to the customs concentrator operated by the Consolidated Mining and Smelting Company at Trail.

Of the hundreds of prospects scattered throughout the Province—some of them recent but the majority old discoveries—many are now being vigorously tested by large mining companies, development syndicates, or individuals, and it can be expected with certainty that some of these will develop into producing mines. Never at any time in the history of the industry has so much money been expended in this particular phase of development. So keen is the search for deposits which have a reasonable chance of developing into mines that some of the shrewdest investors have been willing to bond properties 150 and even 250 miles from the nearest existing railway.

In British Columbia, large areas, most of which are as yet somewhat remotely situated, still remain virtually unprospected. Investigations in these areas, carried out by the Geological Survey in the light of modern geological science and with the advantage of knowledge gained from detailed studies of the well-known mineralised areas, have shown that, over certain sections of these great unprospected regions, geological conditions obtain that are known elsewhere to be favourable to the occurrence of metalliferous deposits. Already a few deposits of promise have been discovered, and there is good reason to hope that on more thorough examination valuable deposits of ore will be found in these, as yet little known, regions.

Even more important at the present time than these unexplored areas are others which are situated much nearer to transportation facilities and which were thoroughly prospected many years ago. At that time many deposits of ore were found that could not, under the conditions then obtaining, be profitably worked. Now, however, owing to advances made in metallurgical practice, as well as to the gradual extension of lines of communication into these areas, and to the use of better mining and transportation machinery, these deposits are of great value and the majority of important mines that have come into prominence in recent years, including the great Sullivan, are resurrections from the discoveries made by a previous generation. Nor is this field yet exhausted but is still of great promise.

One of the recent events bearing out this conclusion is

the discovery in the Whitewater mine, in the Slocan district, of large bodies of good-grade ore extending to the 1,500-foot level and showing every indication of extending to still greater depths. It was not formerly thought probable that ore bodies of this character would persist to such depths, and this discovery together with a similar one made in the Lucky Jim, a neighbouring mine, adds greatly to the future possibilities of this old, but highly productive district.

There are only two reduction works in the province, the large plant of the Consolidated Mining and Smelting Co. at Trail and the smaller plant of the Granby Consolidated Mining, Smelting and Power Co. at Anyox, but, notwithstanding this apparent lack of smelting facilities, over 80 per cent. of the ore mined is exported in the metallic state. The great bulk of the remaining 20 per cent. is exported in the form of "flotation" concentrates to the Tacoma plant of the American Smelting and Refining Co. A subsidiary company to the British Metals Corporation has recently established a sampling plant and bunkering facilities at the site of the old Ladysmith smelter on Vancouver Island from which concentrates are shipped to Wales. The activities of the Consolidated Mining and Smelting Co. in obtaining and developing lines in the coast districts have recently led to the belief that the company is seriously contemplating the erection of a smelter somewhere at tidewater.

Coal is produced mainly from three districts; the Crowsnest district in the south-eastern part of the province, the Vancouver Island coalfields, and a district in south-central British Columbia including Princeton, Coalmont and Merritt. A small amount for local consumption is also produced in the vicinity of Telkwa on the Prince Rupert branch of the Canadian National Railway. Besides the large coal reserves still remaining in these districts the province also possesses extensive deposits in outlying areas too remotely situated to permit of their immediate development. The most important are those on the Peace River, 80 miles west of the Alberta boundary, and those of the Groundhog basin, 80 miles north-east of Stewart. The Peace River coals are of exceptionally high

quality and will, no doubt, play an important rôle in the development of the rich agricultural lands of the Peace River district lying immediately to the east.

The funds necessary for the development of the mineral resources of British Columbia seem to be readily available and come from five principal sources, namely :—(1) Local companies already engaged in the industry ; (2) Local individuals, most, but not all, of whom have derived large profits from the mining industry of the province ; (3) Eastern Canadian mining companies ; (4) British investors and (5) American investors. Formerly the greatest proportion of these funds came from American investors, but of late the amounts coming from certain of the other sources have so greatly increased as, probably, to exceed the amount coming from the United States.

Although United States capital is influential in the control of many companies operating in the provinces, the money now being spent by these companies in developing new deposits is derived from the profits of their local operations and may reasonably be properly considered as of local origin. Conceding this and taking into account the large amounts being spent on new development by these companies as well as by strictly Canadian Companies such as the Consolidated Mining and Smelting Company, and the individuals above mentioned, it appears that of the money now going into the development of the mineral resources of British Columbia, the largest proportion is of local origin, or in other words, it may fairly be stated that the mining industry of British Columbia is now well past the half-way point on the road to becoming self-supporting. In this connection the extraordinary activities of the Consolidated Mining and Smelting Co. are worthy of special mention. These activities not only extend throughout the province, even to the most remote parts, but include all phases of the industry such as prospecting, exploring, placer mining, smelting, refining and manufacturing, and even a well-staffed research department is maintained.

The wave of British capital which invaded the province a few years ago has been to some extent curtailed, but by no means altogether withdrawn. Other opportunities,

however, for becoming profitably engaged in the mining industry of British Columbia are plentiful, and new opportunities are continually arising, but the competition is keen, with the advantage preponderantly on the side of those investors who are willing to take advantage of whatever opportunity may arise and who have representatives on the ground, who are thoroughly familiar with all the local conditions and have authority to act quickly and independently.

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## NOTES

**Fruit Cultivation in Sierra Leone.**—The fruit-growing potentialities of Sierra Leone have been under consideration for some years, and as a result of a meeting of the Tropical Fruits Committee of the Empire Marketing Board held at the House of Commons in July 1926, at which it was decided that the question should be further examined, a *Report on the Question of Establishing Fruit Growing for Export in Sierra Leone* (1927), by M. T. Dawe, O.B.E., Commissioner of Lands and Forests, has now been published.

Separate matters relevant to the enquiry were investigated by Mr. Dawe, who visited California and Florida to ascertain how far the methods of the fruit industry of the United States would be applicable to Sierra Leone, by D. G. Thomas, Assistant Conservator of Forests, who investigated fruit production in the neighbouring Colony of French Guinea, and by D. W. Scotland, Director of Agriculture, who studied at Covent Garden, Hull and Liverpool the questions of packing and shipping for the British market. Reports by these three officials are printed as appendixes to the main *Report*, which is based on their contents and on a journey of inspection undertaken by Mr. Dawe through parts of the Colony to form an idea as to the areas adaptable for fruit growing.

From a consideration of all the information collected the opinion is expressed that Sierra Leone offers good prospects for extended fruit cultivation. There are two types of land in the Colony on which fruit can be grown, the level or undulating area of the eastern section and the hilly or mountainous lands of the western section. The latter would be more difficult to bring into cultivation as it would have to be terraced ; on the other hand it could be irrigated from the numerous streams available, whereas in the eastern section water for irrigation could only be

obtained by pumping from swamps or wells. It is anticipated that, in spite of the high annual rainfall in Sierra Leone, the chief problem in the production of fruit, particularly citrus, will be the maintenance of moisture during the dry months of the year.

It is estimated that there could be made available for fruit growing roughly 14,000 acres in the western area of the Colony and 40,000 acres in the eastern area (including adjacent Protectorate lands), and it is urged that the first step is for the Government to establish Experiment Fruit Farms to test the suitability of the two sections for the production of bananas, grapefruit, oranges, limes, lemons, avocados, pineapples, mangos and tomatoes, and to produce these fruits in sufficient quantities for commercial shipments to be made. It is proposed that there should be two such farms, one of, say, 150 acres in the eastern section, and another of, say, 50 acres in the western section. The cost of these establishments is estimated at a capital sum of £12,000 and a recurrent annual expenditure of £4,120. It is suggested that the Empire Marketing Board should be approached with a view to contributing the capital sum mentioned, the recurrent annual expense being defrayed by the Government of the Colony.

The *Report* contains 32 interesting photographs and a map.

**The Citrus Industry of British Honduras.**—In connection with a publicity campaign on behalf of the Colony of British Honduras that is being conducted by the Belize Literary and Debating Society, with the approval of His Excellency the Governor, the Imperial Institute has received a few copies of an article entitled *Citrus Culture in British Honduras*, by W. A. J. Bowman. The following notes are based on the article in question.

The great possibilities of citrus growing as an important part of the agricultural development of British Honduras are being increasingly recognised in the Colony, and the industry is gradually extending. The marketing of the fruit has been facilitated by the advent of the British Honduras Fruit Marketing Agency, and the product sold under the trade mark "Stanocreek Grapefruit" has won a recognised position in the London market. It is of importance to the commerce of the Colony that the cultivation of the grapefruit should be encouraged.

The native Grapefruit (*Citrus paradisi*) grows throughout the Colony. This variety is noted for its good flavour and productiveness, but is not well suited for export, as it is

rather thin-skinned and easily bruised. In addition there are difficulties in its cultivation, not the least being the height of the tree, which necessitates the use of powerful spray pumps when the application of insecticides is called for and complicates the problem of collecting the fruit. Grafted varieties of grapefruit, originally introduced into the Colony from the United States, have given very successful results and are more suitable for shipment, the "Duncan" and "Marsh's Seedless" being special favourites. The former, in particular, arrives in Canada and in England in excellent condition, and its increased production throughout the Colony is recommended. It is described as possessing the blend of bitterness, acidity and sweetness which constitutes the true grapefruit flavour.

The Shaddock (*Citrus maxima*) is now regarded mainly as a show fruit, and the tree is grown for ornamental purposes.

The Sweet Orange (*Citrus sinensis*) is grown throughout the whole Colony. It includes a number of varieties which yield abundantly and supply the local markets plentifully for about five months of the year. The "Valencia," a late Mediterranean orange, does particularly well in the Stann Creek Valley. Blood oranges are represented by the "Ruby" and "St. Michael" varieties. The Washington Navel has not attained a marked success in the Colony owing to the fact that it does not yield well, but another Navel orange, named "Surprise," is a prolific bearer and produces an excellent fruit.

The Lime (*Citrus aurantifolia*) grows well on poor soil and it is suggested that it might well receive more attention in British Honduras.

The Mandarin and Tangerine Oranges (*Citrus nobilis* var. *deliciosa*) yield well and find a ready sale in the Colony.

The Citron (*Citrus medica*) and Lemon (*Citrus Limonia*) are found scattered throughout the Colony in small numbers, but little interest is taken in their cultivation.

The Sour, Bigarade, or Seville Orange tree (*Citrus Aurantium*) is extensively used as a stock for grafting.

**Wool Production in Peru.**—A valuable report on *The Prospective Development of Peru as a Sheep-breeding and Wool-growing Country* has recently been prepared by Aldred F. Barker, M.Sc., who is Professor of Textile Industries at Leeds University and a valued member of the Imperial Institute Advisory Committee on Animal Fibres. The report was made at the instance of the Peruvian Government, and is based on the author's own experiences in Peru and many other wool-growing

countries. It is pointed out in the preface that the experiences in sheep-breeding and in wool-growing through which Peru is now passing are not merely of local interest but of world-wide importance, and for this reason they are very fully recorded. At the same time the main interest and value of the report are concerned with the prospective development of Peru as one of the world's great wool-producing countries. A good start has already been made and it is foreshadowed that within the next decade the wool clip of Peru may increase fourfold.

Early in 1926 Professor Barker accepted an invitation from President Leguia to visit Peru and to study and report on the results of the first five years' experimental work. It was desired that he should not only report on the experiments at Chuquibambilla but also tour the great sheep-breeding country of Southern Peru where there are some thirty million acres which might ultimately yield about one hundred million lb. of wool annually. The tour was undertaken under the efficient direction of Colonel R. J. Stordy, C.B.E., D.S.O., who is in charge of the experimental work carried out at the Government Model Farm at Chuquibambilla, and it is fully described with the aid of some exquisite photographs taken by Col. Stordy.

It is not possible in this brief note to do more than mention the subjects dealt with in the different chapters, but this will serve as an indication of the lines on which the report has been drawn up. The subjects comprise an account of the author's visit to Peru and his inspection of Peruvian and other South American flocks ; the present position of sheep-breeding and wool-growing in Peru ; a contribution to the science of genetics from Peruvian sheep and wool ; the Granja Modelo de Puno and Col. Stordy's work ; the prospective developments in sheep-breeding in Peru ; the comparative values of Peruvian and " improved " Peruvian wools, illustrated by specimens of cloth manufactured from each ; recommendations based on the foregoing records ; the llamas, alpacas and vicunas of Peru ; and native Peruvian industries and industrial developments.

There are a number of appendixes to the report, dealing with wool fibre diameters and wool qualities ; statistical methods of investigation ; wool analysis and lists of frequency distribution ; the difference between wool and kemp (hair) ; and comparative data regarding the differences in fertility between the Peruvian native sheep and other breeds. A note is included by John B. Speakman, M.Sc., Lecturer in Physical Chemistry in the Department of Textile Industries, Leeds University, on



the milling qualities of native and " improved " Peruvian wools.

Professor Barker is to be congratulated on having produced a most interesting and valuable report, the attractiveness of which is greatly enhanced not only by the photographs already mentioned but also by a number of beautiful autochromes and many carefully drawn charts and graphs.

## RECENT RESEARCH ON EMPIRE PRODUCTS

A Record of Work conducted by Government  
Technical Departments Overseas

### CEYLON

THE following report has been prepared by Mr. F. A. Stockdale, Director of Agriculture, Ceylon, on investigations which have recently been carried out by the Department of Agriculture.

#### I. DERRIS INVESTIGATIONS

For some years interest has been taken in Malaya and Sarawak in species of *Derris*, the extracts from the roots of which have proved to have valuable insecticidal properties. A representative of a firm of dealers in insecticides and cattle dips has recently visited Ceylon, and with the assistance of the Systematic Botanist has been able to study the Ceylon species of *Derris* and to secure samples for investigation. *Derris scandens*, *Derris Benthami* and *Derris uliginosa* are reputed locally as fish poisons, but these investigations showed that *Derris Benthami*, known in Sinhalese as Miung-Kalawel and in Tamil as Karaputekel, is the most common species used. The fruits of *Randia dumetorum* were also found to be commonly used as a fish poison and samples of these have also been secured for investigation. If either of these Ceylon plants should prove as useful as the species of *Derris* found in Malaya and Sarawak it would be possible to secure quite fair quantities from certain districts of the Colony. The following note by the Systematic Botanist on Ceylon species may be of interest :

" The report on different species of Derris is as follows :

1. *Derris Benthami* Karupu-(black) Tekel T. (Trincomalie), Karun-koddi T. (Kantalai), Miung-Kala-Vel S. (Habarane).

The bark of the roots was used as a fish poison at all these localities.

2. *Derris scandens* Welan-(white) Tekel T. (Trinco), Tekel-ankoddi T. (Katiraveli and Kantalai), Sillu T. (3rd ferry Trinco), Bu-Kala-Vel S. (Habarane).

Not used as a fish poison at any of these places except Habarane where considered to be inferior to *D. Benthami*.

3. *Derris uliginosa* Til-ankoddi T. (Trinco) ; name not same as Tekel-ankoddi.

Not used as a fish poison. Grows behind mangrove swamps.

Trimen states that *D. uliginosa* is used as a fish poison. He gives the names Kala-wel S. and Tekil T. for *D. scandens*. He also states that *D. Benthami* is very rare.

Flowers of *D. Benthami* were collected at Habarane in June to confirm the identification. *D. parvifolia* was not found. *D. oblonga* and *D. heptaphylla* are wet zone species."

## II. CHAULMOOGRA OILS

Trial plantations of *Taraktogenos Kurzii* and *Hydnocarpus Wighiana* have recently been made by the Department of Agriculture at Heneratgoda and Peradeniya. A small number of plants of the former, raised from seeds in 1921, are growing satisfactorily at both places and the more recent plantations are making good progress. It was decided to investigate the oils from the seeds of the Ceylon species of *Hydnocarpus*. Samples of *Hydnocarpus octandra* have been submitted for analysis and report to London and Calcutta, and samples of *Hydnocarpus venenata* have recently been secured and will be forwarded to the same places. Other samples from trees thought to be *Hydnocarpus alpina*, growing in the Royal Botanic Gardens, Peradeniya, have also been sent for analysis, but from correspondence which has passed between Calcutta and this country it is probable that these trees are not *Hydnocarpus alpina* but *Hydnocarpus anthelmintica*, a native of

Siam and Indo-China. Correspondence has now been opened with botanical authorities in these latter countries with a view to determining accurately the botanical identification of the plants under reference.

### III. USE OF COCONUT HUSKS

Samples of dried coconut husks have been supplied to manufacturers in Birmingham, England, for certain experiments in regard to special treatment. If some use could be found for the large quantities of coconut husks available, it would be of value to the coconut industry. At present the husks are buried, but they rot with difficulty and the humus they add to the soil could be better met by the use of green cover crops.

### IV. WASTE VEGETABLE PRODUCTS FOR FUEL

Samples of coconut husks, illuk grass (*Imperata arundinacea*) and mana grass (*Andropogon Nardus*) have been supplied to England in connection with trials of the "Hart Process" for the utilisation of waste vegetable products for fuel.

### V. OIL-YIELDING GRASSES

Investigations have been made of the oils of grasses, thought to resemble citronella, found in large areas in the Eastern Province. These oils are not wholly satisfactory and it is certain that true citronella does not occur in this locality. Trials were begun two years ago with growing citronella in the Wewagam Pattu of this Province and growth has been very satisfactory. A small distillery is now being erected for the distillation of the oil.

### VI. ANNATTO

Attempts have been made to secure a market for Ceylon-grown annatto in Australia and New Zealand but so far without success.

### VII. TOBACCO

The cultivation of White Burley tobacco has been continued in the Northern Province and it is estimated that

a crop of about 18,000 lb. of cured leaf will be secured this year for shipment to England. Preliminary trials are this year being made with Adcock tobacco for use in the manufacture of cigarettes at the instance of the Indian Leaf Tobacco Development Company, Ltd.

### VIII. COTTON

The cotton crop in the Southern Province will approximate 2,000 cwts. of seed-cotton this year. The crops were smaller than anticipated on account of unseasonal rains in March. The quality of the cotton was good and Government undertook to subsidise growers on account of the slump in cotton prices. Seed selection is being continued and experiments with rotation crops are being carried out.

### GAMBIA

Mr. Archibald J. Brooks, Director of Agriculture, Gambia, has furnished the following summary of investigations carried out by the Department of Agriculture during the first six months of 1927.

#### I. GROUND-NUTS

(a) *Investigation conducted to ascertain the effect of "Rosette" disease and Ant attack on the "Excess Shell."*—This is a very important factor in the ground-nut trade, particularly in the case of the Gambia, whose chief competitor is Senegal. The ground-nut grown in Senegal is a small variety giving under normal conditions no "excess shell." Unfortunately this variety does not yield well under Gambia conditions, which are vastly different from those in Senegal. The farmers in the Gambia also dislike this variety and will not grow it, as it is more susceptible to disease under our conditions. As the factor "excess shell" comes within the 2 per cent. trade allowance, anything tending to increase it is of vital importance to those engaged in the ground-nut trade in the Gambia.

The following is a copy of the certificate of analyses of a cargo of ground-nuts which reached Bordeaux on April 27, 1927. One half of the cargo was loaded at

Rufisque (Senegal) and the remainder was grown and loaded in Gambia.

	Rufisque 498,030 kilos. Per cent.	Gambia 611,061 kilos. Per cent.
Sand . . . . .	1.203	1.000
Foreign matter . . . . .	1.573	1.074
Excess shell . . . . .	0.000	0.291
	2.776	2.365
Allowance . . . . .	2.000	2.000
	0.776	0.365
Bad kernels . . . . .	0.370	0.719
	<u>1.146</u>	<u>1.084</u>

These cargoes were shipped by the same firm operating in both countries.

"Sand" and "foreign matter" are being eliminated by compulsory screening, but this particular instance happens to be the only cargo shipped from the Gambia this season containing as much as 2 per cent. of "sand" and "foreign matter." The importance of reducing "excess shell" is therefore readily seen.

Details of this work are published in the Annual Report of this Department for 1926-27. The results tend to show that "rosette" disease and ants are important factors in the control of "excess shell," the former increasing the number of empty shells from 34 to 55 per cent. in serious attacks, and the latter from 1.1 to 4.2 per cent.

(b) *Factors Governing Free Fatty Acid*.—Investigations lead us to conclude that the free fatty acid content of a crop of ground-nuts is increased by :

(1) Fungoid disease ; (2) becoming wet either by rain falling, or leaky pumps when in transit in cutters, or from being immersed in water while in transit on river ; (3) insufficient ventilation while awaiting shipment, or in transit ; (4) abnormal amount of "foreign matter" also increases the free fatty acids, probably by heating when in storage.

## II. SESAME SEED (BENI)

Investigations were carried out to test a number of varieties of sesame seed with a view to its providing a second export crop for the Gambia.

Five varieties were tried, viz.: (1) "China White,"

(2) "China Yellow," (3) "Konakry," (4) "Kutny," and (5) "Mozambique." The period of growth was from 92 to 140 days. The yields varied from 151 to 470 lb. of dried seed per acre.

The yield and quality of the oil were as follows :

Variety.	Moisture. Per cent	Oil. Per cent.	Acid value.	Saponification value.
No. 1 . . .	8.09	53.69	0.54	186.60
No. 2 . . .	8.12	52.00	4.26	195.40
No. 3 . . .	4.66	50.03	1.33	188.10
No. 4 . . .	8.99	49.20	4.08	187.57
No. 5 . . .	8.91	52.11	1.54	193.80

## PALESTINE

The following notes have been prepared by the Department of Agriculture and Forests, Palestine, on research on raw materials carried out during the first six months of 1927.

### I. LIQUORICE

Correspondence which originated in the summer of 1927 has been exchanged between the Chief British Representative, Transjordan, the Imperial Institute and this Department regarding the possibilities of developing an export trade in liquorice from Transjordan to England. A sample of undecorticated roots having been submitted to the Imperial Institute for chemical analysis and commercial valuation, an offer of £10 to £12 per ton, c.i.f. London, was made. It was estimated that 1,000 tons might be available in Transjordan. Freight rates from Haifa to London were quoted at 85s. per ton. The Transjordan Government thereupon called for tenders for the right of collection over two areas around Ajloun and Es Salt. No tenders were received. The matter is consequently in abeyance for the time being. However, it is probable that transport facilities in the Jordan Valley will be improved. In that case export of baled liquorice root might ensue. Meanwhile the possibility of local manufacture of liquorice extract should be explored.

### II. TANNIN

The bark of *Acacia melanoxylon* planted as a small shelter belt at Acre Nursery has been analysed by the

Government Chemist. Considerable quantities of seed of tan-bark Acacias have been imported and the following species are being propagated on waste hilly land, in hill forest reserves, and on sand dunes with promising results : *Acacia pycnantha* ; *Acacia decurrens* ; *Acacia mollissima* ; *Acacia cyanophylla*.

### III. SILK

Experimental work in the rearing of silk-worms conducted by the Department in previous years, and sericultural researches carried out by a Mr. Léon culminated in the reference of the data and results obtained to the Silk Advisory Committee of the Imperial Institute and the proposal to insert a sum of £E.300 in current estimates for the purpose of continuing the investigations in progress. The Committee reported that the evidence considered by them definitely suggested the probability that, under skilled management, sericulture could be successfully carried out in Palestine, and notified the impending visit of one of its members to Palestine. Opportunity has since been taken of Mr. N. Breton's arrival to discuss the question. This gentleman has advised that the Government's first duty is to promote the propagation of mulberry trees by importing well-grown saplings and by laying down mulberry stocks at official nurseries for distribution to suitable localities. It is consequently proposed to seek financial authority to expend the indicated sum on the lines suggested.

### IV. WOOL

The Stock-Breeding Service of the Department has recently imported to the new Stud Farm at Acre two pure-bred Merino rams bred in Natal and purchased in Cyprus, and six Meraise rams from Egypt with a view to wool improvement.

### V. ROCK PHOSPHATE

The Geological Adviser reported the occurrence of immense deposits of rock phosphates and suggested that if the material can be used directly in a finely ground condition, without treatment with acid, it could be marketed

at about £E.3 per ton containing 15 to 20 per cent. of phosphoric acid. Arrangements have now been made for 30 tons to be ground, and it is proposed to make comparative tests of local rock phosphate with imported acid superphosphate at official Agricultural Experiment Stations at Acre, Beisan and Jericho with cereals, leguminous crops and fruit trees. A detailed scheme as an extension of current fertiliser experiments is contemplated as well as the application of the rock phosphate on a larger scale to several field crops.

A sample of the material is also to be supplied to the Palestine Zionist Executive for experimental purposes.

## ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY

*In this section a summary is given of the contents of the more important recently published papers and reports relating to tropical agriculture and forestry. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.*

### AGRICULTURE

#### FOODSTUFFS

**Maize.**—During the past few years the mosaic disease has been very prevalent on maize in the sugar belt of Louisiana, and was believed to be the cause of severe losses. In order to obtain definite information on this subject experiments were started at the Louisiana Agricultural Experiment Station at Baton Rouge in 1925. The results are reported in *Tech. Bull. No. 10* (1927), *U.S. Dept. Agric.*, entitled "The Productiveness of Corn as influenced by the Mosaic Disease." The symptoms of the disease in maize during the early growing season are similar to those of the mosaic disease in sugar cane, being most apparent in the young leaves. The mottling may appear as more or less irregular patches or stripes of light-green surrounded by normal dark-green tissue, or the light-green may predominate and entirely surround small islands of normal green tissue. The diseased plants seemed to grow as rapidly as the healthy ones and no dwarfing or shortening of the internodes was observed. The diseased plants tended to sucker slightly more and,



possibly, to produce slightly more ears. The relative yield, the number of suckers, and the numbers and quality of ears produced on diseased and on comparable healthy plants are recorded. The yields from the diseased plants were lower in every extensive comparison, among which the largest difference in yield per acre was  $3.8 \pm 0.69$  bushels, or less than 10 per cent. A larger proportion of the ears from the healthy plants were in the marketable class and the ears tended to be slightly better filled. It was concluded that, under the conditions of the experiments, the mosaic disease was slightly deleterious to the yield and quality of the maize but could not be considered as one of the most important factors in reducing the yield.

**Sugar Beet.**—An investigation of the De Vecchis desiccation process for producing sugar from sugar beet has been in progress for some time at the Institute of Agricultural Engineering, Oxford. A progress report on the work was published in 1926 and a further report, entitled *Desiccation of Sugar Beet and the Extraction of Sugar*, by B. J. Owen, M.A., D.Sc., has now been published by H.M. Stationery Office. The later report is more technical than the progress report and gives a full account, with numerous illustrations, of the various stages of the process, and of the experiments conducted at Oxford.

The principal matters investigated were (1) the conditions governing the drying of sugar beet and the influence of different air temperatures and volumes upon the formation of invert sugar and caramel and the effect upon albuminous substances and other non-sugars; (2) the conditions governing the extraction of sugar from dried sugar beet, and (3) the relation of the several processes to the quality of the sugar. The work has not yet progressed to a stage at which it would be possible to submit any conclusions or recommendations with regard to the drying of sugar beet by the grower. It is proposed to investigate further at the Institute the question of drying *in situ*.

Among the appendixes to the *Report* is one dealing with the treatment of sugar beet effluents.

**Citrus Fruit.**—The *Rhodesian Agric. Journ.* (1927, 24, 1247) contains an article entitled "Citrus Fruit Growing in Rhodesia," which deals with all the important phases of the industry and is written with the object of enabling the beginner to establish and maintain either a small or a large plantation in the best possible manner. Rhodesia has vast tracts of country suitable for the growing of citrus fruits, varying from light sands to heavy loams,

and trees have been successfully established at elevations up to 6,000 feet. The industry has made good progress, as will be seen from the fact that the exports of fruits amounted to 160,000 cases in 1927 as compared with 18,500 cases in 1921. The article deals very fully with soils, selection of site, preparation of the land, laying out the grove, and propagation. The article will be concluded in a later issue of the *Journal*.

**Seychelles Fisheries.**—In a *Report on the Fisheries and Fish Resources of the Seychelles Islands* (1927), James Hornell, F.L.S., F.R.A.I., describes the fishing grounds of the islands, their fish population, and the present condition of the fishing and curing industries. A very large proportion of the inshore fishing carried on in Seychelles waters is of a miscellaneous description, the fishermen using nets, lines and basket-traps (*casiers*) to catch whatever fish may be about; they seldom concentrate upon any one species. The only specific fisheries are for cordonniers, mackerel, the large carangue balo and those found on the outlying banks. The cordonnier fishery is centred in Praslin, where special efforts are made to capture large numbers when the fish assemble in shoals during the breeding season. The fishes caught are cured in quantity for the Mahé market, where they fetch good prices.

The mackerel fishery is principally a seining industry; large numbers are also caught by hook and line. The main season in North-west bay on the west coast of Mahé, its principal scene, lasts from August till the end of October. A single seine haul may effect the capture of several thousand mackerel; such a quantity being too great to be absorbed in one day at the fishing port, the seiner anchors his net in shallow water, reserving alive a portion of the catch for sale on the following day. The carangue fishery is the most important one carried on by Mahé fishermen. The species fished is the giant "carangue balo," commonly weighing up to 24 lb. One of the most prolific grounds is between Mahé and Silhouette, with the Requin shoal as a centre. The carangues are caught on hand lines with sardines and mackerel as bait, and the quantities taken are often so great that fishes of 15 to 20 lb. are offered at two to three annas each. They are highly esteemed by the lower classes, but up to the present local attempts to cure them satisfactorily have been unsuccessful.

Sharks are plentiful on the "barres" or shoals and some of the smaller of them are incidentally caught, cut up and cured for sale by sun-drying without salt. One enterprise has recently taken up shark fishing as a specific

industry, utilising the fins for the Chinese market, rendering down the liver for oil, and curing the flesh for sale in East Africa, but as yet its operations are only on a small scale.

The greater part of the *Report* is devoted to detailed discussions of the methods employed in the fisheries; general conclusions are drawn and specific recommendations made for the improvement of the industry.

#### OILS AND OIL-SEEDS

**The Oil-Palm in Malaya.**—The issue for September-October, 1927, of the *Malayan Agricultural Journal* (1927, 15, Nos. 9-10, pp. 297-386) is devoted entirely to a series of articles, by B. Bunting, B. J. Eaton and C. D. V. Georgi, on the Oil-Palm in Malaya, which have been written with the object of supplying the latest information on the cultivation of the oil-palm on a plantation scale in that country, where the conditions appear to be particularly suitable.

The first large-scale plantation was started in Malaya about ten years ago, and, at the end of 1926, 12,500 acres had been planted. A further 45,000 acres have been definitely allocated to this crop and another 100,000 acres, chiefly in Pahang, have been provisionally ear-marked. Of the area already planted at the close of 1926, 9,357 acres are in Selangor, the remainder being in Johore, Perak, Kelantan and Negri Sembilan. The quantity of palm oil exported in 1926 was 726 tons and of palm kernels 180 tons.

Forty different lots of seed from various palm oil-producing countries of Africa have been imported by the Department of Agriculture with a view to obtaining improved types. They will be used for selection and breeding experiments at the Government Experimental Plantation, Serdang. Until definite results have been obtained it is considered advisable to use seed of the "Deli" type only—a type which is already well established on the East Coast of Sumatra.

As regards the most suitable districts for the establishment of further plantations, it is expected that the flat coastal lands and inland river flats will give the best results, provided they can be properly drained. The Department of Agriculture are proposing to carry out investigations on the growth of the oil-palm on widely different types of soils in order to ascertain which is the most satisfactory.

In establishing plantations, the seeds are best germinated by planting them in sand beds which are covered with glass frames; this method has already been tried

with good results at Serdang. Under these conditions 80 per cent. usually germinate within twelve weeks. The young palms may be transplanted from the nursery beds to the field when they are from 6 to 18 months old, 9 months being considered the best age. The transplanting should be carried out during one of the recognised wet seasons, i.e. October–December or March–April. Under good conditions the most suitable planting distances are 30 ft.  $\times$  30 ft. square (48 palms per acre) or 30 ft.  $\times$  30 ft. triangular (55 palms per acre), the latter system being preferable. As regards upkeep of the plantations, if cover crops are not being grown clean weeding should be carried out. This system, however, is only practicable on flat land, which is not liable to soil wash. The cultivation of cover crops is recommended during the initial stages of development. As the palms increase in age and the ground becomes shaded, a permanent type of cover crop, such as *Dolichos Hosei*, which will thrive under such conditions, should be selected. Owing to varying conditions and differences in types of soil, no definite recommendations can be made as to the most suitable cover plant for general adoption. This question can only be decided by establishing small experimental areas of the more suitable types of cover plants on the estate. *Tephrosia candida* and *Crotalaria anagyroides* are recommended as green manures. In estates liable to soil wash, terracing, ditching and cover crops are suggested. On some plantations the ground between the rows of palms is regularly ploughed or disc-harrowed with beneficial results. Manuring of oil-palm plantations has hitherto not received much attention. In order to determine the amounts of the different plant nutrients removed from the soil by palms when in bearing, the Department of Agriculture are undertaking a chemical examination of the leaves, flowers and fruits grown under different soil conditions. The results of this investigation will indicate the nature of the artificial fertiliser required. When the palms have reached the producing stage they should be judiciously pruned. The minimum amount of pruning gives the best results.

Catch-crops may be a valuable source of revenue during the initial years of the plantations, but as the oil-palm develops rapidly such crops should be of comparatively short duration. Experiments with cassava are at present being undertaken at Serdang. In some cases, where wide planting has been adopted, robusta coffee has been successfully cultivated as a catch-crop. During the early stages of production attention must be given to artificial pollination in order to obtain satisfactory yields of fruits, but care

must be exercised as excessive artificial pollination has been shown by experiments at the Experimental Plantation, Kuala Lumpur, to result in the reduction both of the size of the fruits and of the percentage of pericarp. In order to confirm these results, experiments on a much larger scale are now in progress at Serdang.

The chief diseases which have been observed on the various oil-palm estates in Malaya are : bud-rot of mature palms ; crown disease of young palms ; marasmus disease of fruit bunches, and two other uninvestigated affections of fruit bunches. Brief descriptions of the symptoms of each disease with suitable measures for treatment are given.

The oil-palm in Malaya is at present singularly free from injurious insects and none has yet proved of economic importance. Among the insects recorded as causing damage are : the red-stripe weevil (*Rhynchophorus Schach* Oliv.) ; the black or rhinoceros beetle (*Oryctes rhinoceros* L.) ; white ants (*Coptotermes gestroi* Wasm.) ; the " case-worm " (*Mahasena* sp.) ; and the short-horned grasshopper (*Valanga nigricornis* Burm.). Measures for control of these pests are described.

Details are given relating to the harvesting and collection of the fruit. The average composition of ripe fruit is : pericarp, 57-60 per cent. ; nuts, 40-43 ; moisture in pericarp, 29-40 ; oil in pericarp, 48-57 ; palm oil (calculated on dry pericarp), 76-80 ; shell in air-dried nuts, 75-82 ; kernels in air-dried nuts, 18-25 ; palm oil (calculated on fresh fruit), 29-32 ; kernels (calculated on fresh fruit), 6.5-8.5.

The following table gives the estimated yields of fruit, pericarp, palm oil and kernels per acre at different ages. The following factors have been taken as a basis in making these estimates : number of palms per acre, 55 ; percentage of pericarp in fresh fruit, 58 ; yield of palm oil from fruit, 25 per cent. ; yield of kernels from fruit, 6.25 per cent.

Age of palm.	Fruit per palm per annum. lb.	Fruit per acre. lb.	Pericarp per acre. lb.	Palm oil per acre. lb.	Kernels per acre. lb.
4th year . . .	35-40	2,100	1,200	500	125
5th-6th year . .	70-75	4,000	2,300	1,000	250
7th-8th year . .	100-105	5,600	3,200	1,400	350
9th-10th year . .	115-120	6,500	3,800	1,600	400
After 10th year .	130-135	7,300	4,200	1,800	450

In Malaya only ripe undamaged fruit is used in the preparation of palm oil. The fruits are sterilised before treatment and are then worked up for the oil as quickly as possible. The centrifugal system of separating the oil is generally used in Malaya and an efficiency of 85 to 87

per cent. is obtained. The kernels are separated from the broken shell by means of a suspension of clay in water. Locally grown woods have been tried for the manufacture of the barrels in which the palm oil is shipped ; " Nyatoh " and " Mersawa " have given satisfactory results while " Kapur " has been shown to be unsuitable.

Palm oil exported from Malaya contains from 3 to 5 per cent. of free fatty acids. It is considered that the premium of 1s. 9d. per ton, allowed to the seller for each one per cent. below the basis of 18 per cent. of free fatty acids, is not commensurate with the extra expense incurred. However, the plantation product is now being sold principally on the specification of buyers who offer a higher price than the prevailing rate for Lagos oil, even after allowance has been made for the premium.

Estimated returns are given for a plantation of 2,000 acres, fully equipped with proper transport facilities, plant and machinery, and all the necessary buildings. The figures are based on an annual yield of 16 cwts. of palm oil and 4 cwts. of kernels per acre ; an average " all in " cost of production of £25 per ton of palm oil and £10 per ton of kernels ; and a selling price of £35 per ton for palm oil and £20 per ton for kernels. The estimated returns show an annual profit of £10 per acre. As the estimated capital outlay should not exceed £45 per acre, this profit is equivalent to about 22 per cent.

In order to dispel the doubts raised by Yves Henry as to the remunerativeness of oil-palm cultivation in Sumatra (see this BULLETIN, 1926, 24, 694 ; 1927, 25, 162), a special investigation has been undertaken at the instigation of the Algemeen Proefstation of the A.V.R.O.S. and the results are published in a recent number of *Bulletin des Matières Grasses* (1927, No. 12, p. 317). This investigation showed that the reduced yields quoted by Yves Henry may probably be correct, but only in the case of the early plantations. This falling-off of the yields is due to mistakes made owing to lack of experience, such as the failure to employ clean weeding, the introduction of inferior seed, the lack of efficient care of the plantation, and insufficient manuring. From the later plantations better results are expected, such as are estimated by Rutgers, and a better yield and quality of oil will be obtained owing to the use of modern machinery. Plantations on suitable soil give high yields, which, for palms 7 or 8 years old, are from 2-2½ tons of oil per hectare. By employing intensive methods of cultivation these yields will be maintained and may even be increased.

The conclusion drawn from the results of this investigation is that the cultivation of the oil-palm in Sumatra gives a satisfactory return and may be regarded as a sound investment, particularly in the case of modern plantations producing a quality of palm oil suitable for margarine.

### ESSENTIAL OILS

**Geranium Oil.**—An interesting article by C. Chalot on the production of geranium oil (*Pelargonium roseum* Willd.), of which France and her Colonies possess practically a monopoly, appears in *La Parfumerie Moderne* (1927, 19, 136). The centres of production are Réunion, Algeria, Grasse (S. France), Madagascar and Corsica. The quantities exported from Réunion and Algeria for the years 1923, 1924 and 1925 were, respectively, Réunion 839, 1,155 and 1,732 quintals, and Algeria 298, 155 and 72 quintals. The exports from Réunion have shown an almost steady increase since 1901, when 194 quintals were exported. On the other hand, those from Algeria, the next important producer, have been regularly declining from 466 quintals in 1908. The South of France produces about 2,000 kilos. each year and Corsica 600 to 1,000 kilos.; Madagascar exported 787 kilos. in 1925. Grasse furnishes the best oil, which commands a price about three and a half times that of the Réunion and Algerian oils.

The geranium plant flourishes in a warm dry climate, and is multiplied by cuttings taken from plants producing the maximum amount of leaf. Owing to frosts only one crop a year is possible in France, whereas in Algeria two or three crops are obtainable, provided that there is not too much cold and according to whether or not the land is irrigated. In any case the plants occupy the ground for from 4 to 8 years. In Réunion also the plants are kept for several years if the yield of leaves continues satisfactory, but they are only grown in the most permeable soils and at an altitude from 400 to 1,200 metres. In the Maritime Alps the best results are obtained by planting the rooted cuttings at a distance of one metre each way, or 10,000 to the acre. Persistent rains in Réunion cause a disease known as rust, which might be prevented if a greater distance was allowed between the plants. It is also to be noted that on non-irrigated land a smaller yield of oil is obtained, but of finer quality. When three crops of leaves are taken, the second furnishes the highest yield of oil, and the third the lowest. In Réunion the application of superphosphate of lime to the extent of 1,000 kilos. per hectare per annum has been found almost

to double the yield of oil. On the other hand chloride of potassium and nitrate of soda have proved deleterious to the plants.

The crop consisting of the leafy twigs is harvested by means of sickles or sécateurs, just before the plant flowers, when the leaves begin to turn yellow and their scent is more like that of roses and less like that of lemon. The annual yield of oil per hectare in Algeria is stated to be 25 to 30 kilos. The amount of oil obtained from the fresh leaves varies somewhat in the different countries. The following figures are quoted : France 0.1 to 0.2 per cent., Corsica 0.125 to 0.166 per cent., Réunion 0.106 to 0.14 per cent. Calculated on the dried material, the yield is about 0.6 per cent. With a yield per hectare of 25 kilos. of oil, assuming a selling price of 220 francs per kilo., 5,500 francs per hectare would be realised. From this, however, about 50 per cent. must be deducted for expenses. Although the market price of geranium oil has fluctuated a good deal during recent years owing to over-production, it is considered that the prices obtainable will always prove remunerative.

The author encourages further development in the industry in Réunion and Madagascar, and recommends that planters should pay due regard to the necessity of cultivating selected varieties under suitable conditions of soil, climate and altitude, and allow sufficient space between the plants. Attention should also be given to the selection of appropriate manures, and finally the installation of modern steam stills is advocated.

## FIBRES

### *Cotton*

**Queensland.**—Two useful articles on the cotton-growing industry of Queensland have been published recently in the *Queensland Agric. Journ.* (1927, 27, 459-485 and 589-613).

The first of these, written by W. G. Wells, Cotton Specialist, gives an account of the more important phases of the cultivation, including climate, soils, planting, tilling the soil, thinning, picking, grading, ginning and marketing, and emphasis is laid on the desirability of keeping the industry on a one-variety basis. Reference is made to the state of the industry, which at present is in a stage of transition between a system of assistance under Government control and unassisted control by the growers. The system of Government-guaranteed advances during 1919-1926



was designed to enable the growers to learn the fundamental principles of cotton-growing. At the termination of this period the growers requested the Commonwealth Government to grant a system of bounties on seed-cotton for a term of years. The Government, realising the importance of developing the industry, accordingly granted a bounty of  $1\frac{1}{4}d.$  per lb. on the better grades of seed-cotton and  $\frac{3}{4}d.$  on the lower grades for a period of five years, starting with the season of 1926-27. In conjunction with this bounty it was decided to develop a cotton-spinning industry in Australia, and a graduated bounty has been granted varying from  $\frac{1}{4}d.$  to 1s. per lb. of yarn manufactured in the Commonwealth, providing it contains 50 per cent. of Australian-grown cotton. The growers have therefore a period of five years in which to improve their cotton-growing practice. The Queensland Department of Agriculture is affording assistance by conducting large numbers of experiments both in co-operation with growers and at the Callide Cotton Research Station. It is considered that with the cotton-spinning industry practically assured in the country there is an excellent future for cotton-growing in those parts of the State in which the plant can be successfully cultivated. These areas have now been fairly well ascertained and, generally speaking, they lie along the slopes and medium alluvial loamy flats of the valleys of the eastern watershed of the Great Dividing Range, from north of Beaudesert in the south to the Fitzroy River and areas adjacent in the north, and lying in behind the coastal ranges from Brisbane to Gladstone and thence north to Rockhampton. This covers an area of some 400 miles long by 50 to 150 miles wide. A sketch map is provided in which these areas are indicated.

The second article has been contributed by E. Ballard, B.A., F.E.S., Commonwealth Cotton Entomologist, and deals with the insect pests of cotton in Queensland. The various insects which attack the crop are described with a number of excellent illustrations, and methods of control are indicated. In concluding the article Mr. Ballard makes the following remarks :

" After seeing such a list of pests one might be tempted to ask, ' Can cotton possibly be grown at all ? ' The answer to that question is that even in poor seasons excellent crops have been harvested. In 1926, in the face of one of the biggest Corn Ear Worm attacks which the writer has seen, 1,200 and 1,500 lb. to the acre from a November-planted crop were secured on the Cotton Research Station at Biloela, by using a trap crop of maize. Early planting is advisable for many reasons, and, as has

been seen, this also is of great assistance in checking or avoiding pests."

It is pointed out that more than half the control lies in the hands of the farmer himself. Insects must be regarded as a constant factor in farming and precautions must be taken to control them.

### *Paper-making Materials*

An article on the production of paper-pulp from Australian timbers has been published in the *Journal of the Council for Scientific and Industrial Research, Australia* (1927, 1, 65). At the present time straw is the only locally produced raw material used for pulp manufacture in the Commonwealth and large quantities of this are converted into strawboard. In 1918 the question of determining the suitability of other indigenous materials for paper-making was considered by the newly-formed Advisory Council of Science and Industry, and experiments were made with the wood of eucalypts and with a number of grasses and sedges. It was found that the eucalyptus woods when treated by the soda process under suitable conditions yielded pulps which could be used for book and fine printing papers. (Good results were also obtained with the wood of the candlenut tree (*Aleurites moluccana*) from North Queensland, which gave a yield of 62 per cent. of cellulose.) Among the woods of exotic conifers tested, that of *Pinus insignis* was found to give a strong pulp which was suitable for wrapping-paper but was not bleachable by ordinary means. The difficulty was overcome, however, by producing a mildly cooked, strong, brown pulp and treating it first with chlorine water and subsequently with a weak hypochlorite bleach. A similar but rather stronger pulp can be produced by the sulphate process.

A careful systematic study of the pulping of eucalypt wood by the sulphite process has shown that under particular conditions a yield of as much as 60 per cent. of an easily bleachable pulp can be obtained which is suitable for newsprint. A small complete pulp and paper mill is now being erected in Tasmania by a well-known Company to investigate the value of the material for use on a commercial scale.

Experiments have also been made on the production of a mechanical pulp from eucalypt timbers, notably those of *E. regnans* and *E. obliqua*, and it has been found that when 30 per cent. of such pulp is used in admixture with 70 per cent. of sulphite pulp, paper can be obtained in the laboratory which is stronger than standard newsprint.

## TOBACCO

**Manurial Trials.**—During the last few years experimental work has been conducted by the Bureau of Plant Industry, United States, to determine the effects of the various forms and rates of application of manures on the yield and quality of flue-cured tobacco. The experiments were carried out in co-operation with the agricultural authorities in North Carolina, Virginia and Georgia at three places within the Piedmont region and at the same number in the Coastal Plain territory. The results are published as *Tech. Bull. No. 12 (1927), Dept. Agric., U.S.A.*, entitled "Fertiliser Tests with Flue-cured Tobacco." Various natural and artificial manures were used and the data collected are representative of the flue-cured tobacco district, especially of the old-belt section. The soils of this area are more or less deficient in plant food, thus rendering the production of tobacco dependent on the use of manures. As far as the tests indicate, phosphoric acid is an essential constituent of the mixed manure required for all soils of the flue-cured tobacco district, especially in the case of virgin soils, and it was found that acid phosphate gives better results than basic slag or raw bone meal as the source of the phosphoric acid. The need for carefully controlling the ammonia supply for growing bright tobacco is pointed out, the quantity required varying with the season, soil and source. It is shown that as much as 30 to 40 lb. per acre can be used with the production of a satisfactory yield and quality of leaf. Various sources of ammonia were tried, and it was found that a mixture of nitrate of soda, ammonium sulphate, dried blood and cotton-seed meal usually gave somewhat better yields of tobacco than any of these materials when used alone, and there was no decided difference in the quality of the product. The tests showed that over a period of years about 40 to 60 lb. of potash per acre is sufficient, but higher rates gave greater resistance to leaf-spot diseases. In these tests muriate gave higher yields than sulphate of potash, but there is a tendency for the chlorine to injure the combustibility of the leaf. A portion of the potash, however, may be safely derived from potash salts containing chlorine without serious detriment to the combustion provided the quantity of chlorine supplied is not more than 20 to 25 lb. per acre. The magnesia requirement of tobacco is low, but the results of the tests show that on some soils its inclusion in a compound manure is necessary. It may be supplied in the form of potash salts containing magnesia or by the application of ground magnesian limestone. The

results recorded do not show any great benefit from liming apart from that due to the magnesia contained in the limestone.

**Northern Rhodesia.**—During the season 1926 the area under tobacco in Northern Rhodesia was 4,939 acres, being an increase of 616 acres over that of the preceding year, while the crop amounted to over two million lb. of leaf as compared with 673,000 lb. in the previous year. The greater portion of the crop consisted of bright Virginian leaf, and according to the *Agricultural Report for 1926, Dept. Agric., Northern Rhodesia*, there are indications that the tobacco industry may become of considerable economic importance. Tobacco planting in the Western Districts is still in the experimental stages, but in the Fort Jameson District the crop has been grown for some years and many of the planters have had considerable experience. The Government have appointed a Tobacco Adviser to assist farmers hitherto unacquainted with the crop, and trial crops were planted over a large area. It is hoped by this means to promote the production of a leaf of high standard. Soils and climatic conditions in the majority of districts surveyed by experts of the United Tobacco (South) Limited were regarded as favourable, and it was considered that on many farms leaf of good grade could be produced.

## RESINS

**Lac.**—The Indian Lac Association for Research has issued *Reports* covering its activities from its inception in August, 1921, to the end of March, 1927. The Association, managed by a Committee of Europeans and Indians representing all branches of the trade, was founded under Government auspices, and completed the establishment of a Research Institute in 1925, together with an experimental plantation of about 85 acres near Ranchi in Bihar and Orissa in the heart of the lac-growing districts. The Institute is endeavouring to obtain some insight into the methods of production of crude lac, with a view to securing an increased yield and an improvement in quality. Methods of manufacture of shellac will also be investigated, and efforts will be made to standardise results. These problems entail the discovery of the most suitable host trees and the best methods of cultivating them, and also include an exhaustive study of the lac insect and its enemies which is to be especially directed to the production of stronger and more immune brood-lac. As India enjoys

practically a monopoly of the lac industry, it is desired to stabilise the trade in every possible way, so that with an increased production and a lower and less variable price, it may be secure against competition from foreign sources and from synthetic substitutes. A staff of over twenty persons is employed, with Mrs. Dorothy Norris, M.Sc., A.I.C., as Director and Biochemist. The enterprise is of course of too recent inception to have revealed much of importance; progress, however, has already been made in finding suitable conditions for the rapid growth of young host trees.

Reference was made in a previous number of this BULLETIN (1924, 22, 363) to the production of lac in Indo-China; further information on the stick-lac industry in Cambodia is given in *Bull. Économique de l'Indochine* (1927, 30, 115). Although the occurrence of the lac insect is very general throughout Cambodia the production of stick-lac is confined to certain districts. Seven species of trees are commonly employed by the natives as hosts for the insects. Three are leguminous forest trees, three are species of *Ficus*, and the other is a small tree belonging to the natural order Combretaceæ. The natives have always made use of the species which happens to be the most common in the neighbourhood, but during the last four years small plantations of *Ficus* spp. have appeared in the villages. Until recently the lac was cultivated almost entirely for local consumption, but since 1920 a development in the industry has taken place owing to the demand for stick-lac in Europe, and the cultivation has spread to fresh districts. Owing to the fact that its original use was as a colouring matter, it is difficult to dissuade the natives from their conviction that the value of the lac depends on its richness in lac dye, and it is not easy to prevent them from choosing those trees which produce the darkest lac. Trees furnishing the darkest lac have thus been preserved at the expense of other more suitable indigenous host plants, and almost all the stick-lac of Cambodia is very dark in colour. The industry is carried on in a primitive manner; much of the best lac is wasted and many of the insects needlessly destroyed. One collection takes place annually, generally prematurely, from the end of September to the end of November, so that the colour and quality of the product suffer in consequence. Two hatchings of insects occur in the year, but as a rule little is harvested in the summer. The product is sold to Chinese merchants, who in drying it for export generally contrive to include enough mineral

impurity to make up for the loss in weight, which amounts to nearly 30 per cent. The price obtained for the lac, assuming a maximum loss on drying of 30 per cent., works out at about 60 piastres a picul of 60 kilos. on the dry material.

### TANNING MATERIALS

**Morocco.**—A survey of the tannin resources of Morocco has recently been communicated by M. Em. Miège, head of the experimental agricultural service in that country, to *Bull. de la Soc. d'Encour. pour l'Ind. Nat.* (1927, **128**, 645-662), in which he deals with botanical characteristics, habits of growth, location, tannin content and commercial value of the wild and cultivated tanning materials.

The leather industry, which is especially flourishing in Morocco and plays an important part in its export trade, requires numerous tanning materials which are for the most part found or produced in the country itself. Some of these are exported, and only very small amounts are imported.

Up to the present the natives do not attempt to cultivate the various plants, confining themselves entirely to those growing wild in the country. These include the following:

*Tizra, tezera*, or *seqqoum* (*Rhus pentaphylla* Desf., N.O. Terebinthaceæ). This is a thorny bush, resembling hawthorn, which grows to a height of 2-3 metres and to a circumference of 5-6 metres. It is of extremely slow growth, and is estimated to require 200 years to attain a useful size. The wood, which is very hard, compact, and free from knots, takes a good polish and may be employed in cabinet-making. The tree is found throughout the whole of North Africa, and is widely distributed in Morocco. According to the author different parts of the bush contain the following amounts of tannin: dried leaves, 1.1 per cent.; wood, 2.4 per cent.; root bark, 5.25 per cent.; bark of large branches, 10.1 per cent.

The plant is mainly employed as a source of colouring matter and is but little used by the natives as a tan-stuff, although the root bark has long been so employed by the tanners of Kairouan.

**Takaout.**—This is the gall found on the branches of *Tamarix articulata* Vahl. The tree, known as "tlaia," grows well in the steppe lands, having been imported from the Sahara in 1883. It prefers the coastal regions but also grows satisfactorily inland. It is an extremely valuable species, is vigorous, hardy, resistant to drought,

heat and cold, grows rapidly and multiplies freely. The tree attains large dimensions, especially in its home in the Sahara; when pruned regularly it makes an admirable wind shield, and is used in this way to protect orange trees.

The galls (adzba) only appear after the tree has reached a certain age and size and has flowered. A good tree is said to produce about 25 kilos. of galls per annum.

Takaout is used by the natives and is an article of commerce, the trade being localised mainly at Marrakesh; the galls are collected usually in October or November and carried by caravans to the market. The tanners in Marrakesh recognise three qualities, takaout draouia, takaout Skoura, and takaout Ghrisia, and there is also that of Tafilalet, less known and less appreciated. The best quality is draouia, which contains the most tannin and is used in the tannage of goat skins; Skoura is used for sheep skins. The average tannin content of takaout is about 40-45 per cent. Fresh galls give a pale tannage, slightly coloured rose or violet; on ageing the pelt becomes darker and of a brownish tint. The present value of takaout is about 2.5 francs per kilo. at Marrakesh.

*Oaks.*—A number of species of North African oak furnish tannin from the bark, fruits or galls. The principal one in Morocco is the cork tree (*Quercus suber*). In 1925-26 this tree furnished 10,000 quintals of tan bark, containing 10.13 per cent. of tannin, which was used almost exclusively in the local tanning industry. In Morocco the cork tree covers 250,000 hectares, and the evergreen oak (*Quercus Ilex*) 200,000 hectares, while the "chêne zeen" (*Quercus Mirbeckii*) is less plentiful. The cork tree grows to a height of about 10-12 metres and to a circumference of 1.2-1.5 metres, whilst the evergreen oak attains a height of about 8 metres and a diameter of 30-40 cm.

*Other Species.*—Brief mention is made of other trees yielding tannin which grow wild in Morocco. These include the bark of the Aleppo pine, the leaves of *Pistacia lentiscus* (dherou, batoum), the barks of the pomegranate and date trees, the nuts of *Areca catechu*, the gall-nuts of *Quercus infectoria*, the leaves of *Osiris lanceolata*, and the plants of *Solanum sodomæum* (containing 47 per cent. of tannin) and *Scilla maritima* (containing 24 per cent. of tannin). The two last, although abundant in Morocco, do not appear to be used by the natives as tanning materials, nor are they exported as such.

The latter part of the article deals with well-known

tanning materials which have been introduced into Morocco and which are now cultivated, mainly by Europeans, for the production of tan-stuffs. These include *Coullertia tinctoria*; sumach (*Rhus coriaria*); *Acacia* spp., principally *A. decurrens*, *A. pycnantha*, and particularly *A. mollissima* (*A. decurrens* var. *mollissima*), the black wattle, and *A. cyanophylla*; and *Eucalyptus* spp., including *E. rostrata*, and *E. occidentalis* which furnishes mallet bark.

**Galls of *Pistacia atlantica*.**—Amongst samples sent to the Royal National Institute for the Leather Industry of Torino (R. Istituto Nazionale per le Industrie del Cuvio di Torino) in response to a request made by the Institute through the Italian Colonial Office for samples of the chief colonial vegetable tanning materials for examination, were samples of the leaf galls of *Pistacia atlantica* Desf., sent from the R. Ufficio Agrario per la Tripolitania, of Tripoli. The results of examination of these galls by G. A. Bravo have been published in the *R. Stazione Sperimentale per l'Industria delle Pelli e delle Materie concianti, Bollettino Ufficiale* (1927, 5, 204).

*Pistacia atlantica* Desf. (= *P. terebinthus* L. var. *atlantica* Desf.) belongs to the family Anacardiaceæ. It is a tree growing to the height of about 15–20 metres, with a circumference, at a man's height from the ground, of 4–5 metres. The plant, according to Trotter (*Flora Economica della Libia*, Roma, 1915, 218), is cultivated to a small extent in the oases near the coast of Tripoli, Tagiura, Zliten, Homs, and Misurata; it grows wild in the rocky districts of the northern slopes of Gebel, and near the streams of the pre-desert zone, where isolated, generally old, specimens are met with.

Vignolo-Lutati (*L'Industria Chimica*, Torino, 1913, 18, 23) found the leaves to contain 19·74 per cent. of tannins and 21·12 per cent. of soluble non-tannins, and recommended the material as a substitute for sumach.

Parasites frequently attack the leaves of *P. atlantica* forming characteristic galls, of which the following are described in the present article.

*Pemphigus cornicularius* Passerini. This transforms the whole leaf into a horny growth of varying shape, reaching a length of 15–20 cm. and a breadth of 2–3 cm. The galls are brownish-purple in colour, and have a strongly resinous odour.

*Pemphigus Riccobonii* Stefani. With this the galls are composed of 10–12 swellings corresponding with the same number of internal cavities. Only a few examples of these



galls have been found intermixed with those described later.

*Pemphigus utricularius* Passerini. This forms galls more or less rounded in shape attached to the veins of the leaf, and developed chiefly on the lower part. They are yellow, yellowish-brown or reddish in colour, generally 4-8 mm. in diameter and 0.2-0.3 grm. in weight, though some may reach a diameter of 16-17 mm. with a weight of 1.5 grm.

The above galls have been examined by the author with the following results :

	<i>P. cornicularius.</i>	<i>P. Riccoboni.</i>	<i>P. utricularius.</i>	
	(Filter method.)	(Filter method.)	(Modified shake method)	(Filter method.)
Tannin . . . . . <i>per cent.</i>	24.04	29.21	37.76	40.32
Soluble Non-Tannins. . . . . "	20.32	25.74	15.28	12.72
Insoluble Matter . . . . . "	45.01	34.46	35.30	35.30
Moisture . . . . . "	10.63	10.59	11.66	11.66
Ash . . . . . "	4.90	4.10	3.87	3.87

The galls formed by *P. utricularius* are those most frequently found in Tripoli, where they form an article of commerce and are sold by druggists and herbalists under the names "Afs" and "afs-el-batūm." They are used by the natives for dyeing light skins, their price in 1913 being 1½ lire per kilo. The sample of *P. utricularius* galls examined contained leaves, small branches and other extraneous material, after removal of which slightly higher results for tannin were obtained.

No statistics of the production and commercial use of these galls in Libya are available. They have not been intensively cultivated or regularly used in the dyeing industry, but laboratory tanning tests have shown that they produce very good leather and could be employed as a substitute for other tans used for light skins.

The galls contain gallic acid and might be employed in the manufacture of inks.

## FORESTRY AND TIMBERS

**The Teak Industry of Siam.**—A monograph under this title by D. R. S. Bourke-Borrowes, late Adviser to the Royal Forest Department, Siam, published as a Supplement to the *Siam Record*, October, 1927, gives an interesting account of the Northern Siamese teak zone and

its forests, and the occurrence, silviculture and exploitation of the teak. The forests of this zone are of various types, those in which teak is found being of the mixed deciduous type. The teak-producing areas are estimated to cover some 10,000 square miles or about a quarter of the total area of Northern Siam. It is claimed that in this zone the tree attains dimensions at least as large as anywhere else in the world. The extreme altitude at which it is found is 3,000 feet, though it seldom occurs in any quantity above 2,500 feet, an elevation considerably less than the greatest heights at which it grows in Burma and India.

The publication deals with the work of the Royal Forest Department in Northern Siam in relation to the teak trade and the development of the teak leases, the past output of the teak forests, the organisation of forest working, the felling, logging and transport of the timber, and its milling, grading and shipment to the world's markets.

The concluding section gives an account of the characteristics of teak in general and Siamese teak in particular. Siamese teak, like that grown elsewhere, shows variations in colour, hardness and other qualities, depending on soil, elevation and latitude, but in general the Siamese wood resembles that of Burma. There is a local belief, supported by experience, that the slow-grown timber produced on the stony lands of the foothills and lower mountain slopes is harder, stronger and more durable than the faster-grown timber of the low-lying basin deposits. Siamese teak is sometimes found to exhibit a "bird's-eye grain" due to the presence of burrs, and sometimes yields a timber with a fine figured or mottled pattern, known as "flowered teak." In both these cases the wood is highly esteemed.

The work is illustrated by a number of excellent photographs and a useful map.

**Seasoning of Timber.**—The Forest Products Research Laboratory of the Department of Scientific and Industrial Research have issued as *Special Report No. 1* (1927), entitled "The Air-Seasoning and Conditioning of Timber," a useful summary of information to serve as a basis for understanding the problems and practice of timber seasoning. The Report has been prepared as a result of enquiries received at the Laboratory and discussions with various wood-using industries, and is intended to serve as an introduction to further publications by the Laboratory on the subject in question.

The structure of wood is described, with the aid of

a number of micro-photographs ; the moisture content of wood is considered in its relation to atmospheric humidity and weather conditions, and the method of determining it is explained ; air-seasoning and its difficulties are then dealt with, and finally there is a short appendix on the decay of timber caused by fungi and its prevention.

#### MISCELLANEOUS

**Turtle Fisheries of Seychelles.**—A monograph by James Hornell, F.L.S., F.R.A.I., entitled the *Turtle Fisheries of the Seychelles Islands* (1927), gives an interesting description of the Green and Hawksbill turtle industries of the islands. These two species of marine turtle are found in considerable numbers, while a third species, the Loggerhead turtle, is occasionally caught, but it has no importance, and unlike the other two species it appears not to breed anywhere in the archipelago. The fisheries for the Green and Hawksbill turtles are of great importance to the islanders ; the flesh of the former, fresh or salted, largely takes the place of beef amongst the lower classes of the population, whilst the calipee made from the tough cartilaginous tissue between the bones of the carapace and plastron of the same species, and the oil extracted from the fat are valuable sources of income to the lessees and owners of certain islands. The shell of the Hawksbill turtle, the tortoiseshell of commerce, ranks high among the exports of the island, and so important to the general community is the continued prosperity of these fisheries that regulations for their protection have been enacted by the Government. All phases of the industry are dealt with in the monograph, including breeding habits, migration, methods of capture and the manufacture of the various turtle products.

## BIBLIOGRAPHY

*Comprising the more important reports, articles, etc., on plant and animal products, contained in publications received in the Library of the Imperial Institute during the three months November 1927-January 1928.*

*The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.*

## AGRICULTURE

## General

Seventeenth Report of the Development Commissioners for the Year ended March 31, 1927. Pp. 178, 9½ × 6. (London: Stationery Office, 1927.) Price 3s.

Agricultural Research in the British Empire. VI—Agricultural Research in the Colonies and Dependencies. By J. S. Thomson. *Scottish Journ. Agric.* (1927, 10, 382-387).

Agricultural Research in the British Empire. VII.—The Research Grants of the Empire Marketing Board. By W. G. A. Ormsby-Gore. *Scottish Journ. Agric.* (1927, 10, 388-394).

Twenty-first Annual Report of the Department of Agriculture, British Columbia, for the Year 1926. Pp. 120, 10½ × 7½. (Victoria, B.C.: Printer to the King, 1927.)

Annual Report of the Director of Agriculture, Cyprus, for the Year 1926. Pp. 19, 9½ × 6½. (Nicosia: Government Printing Office, 1927.)

Report of the Department of Agriculture, Bermuda, for the Year 1926. Pp. 70, 12 × 8. (Hamilton, Bermuda: The Bermuda Press, 1927.)

Annual General Report of Jamaica together with the Departmental Reports for 1926. Pp. 436, 13 × 8½. (Kingston, Jamaica: Government Printing Office, 1927.)

Report on the Agricultural Department, St. Vincent, for the Year 1926. Pp. 37, 13 × 8. (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1927.) Price 6d.

Administration Report of the Director of Agriculture, Trinidad and Tobago, for the Year 1926. *Council Paper No. 90 of 1927*. Pp. 42, 13½ × 8½. (Port-of-Spain, Trinidad: Government Printer, 1927.) Price 1s. 6d.

Report on the Agricultural Department, Gold Coast, for the Period April 1926-March 1927. Pp. 12, 13 × 8½. (Accra: Colonial Secretariat; London: Crown Agents for the Colonies, 1927.) Price 1s.

Year Book, Department of Agriculture, Gold Coast, 1926. *Bull. No. 7*. Pp. 111, 9½ × 6. (Accra: Government Printer, 1927.)

Proceedings of the First West African Agricultural Conference, held at Ibadan, Nigeria, March 1926. Pp. 196, 10½ × 8½. (Lagos: Government Printer, 1927.)

Annual Report of the Department of Agriculture, Kenya, 1926. Pp. 210, 9½ × 6½. (Nairobi: Government Printer, 1927.) Price 5s.

Annual Report of the Department of Agriculture, Northern Rhodesia, 1926. Pp. 51, 12½ × 8. (Northern Rhodesia: Department of Agriculture, 1927.) Mimeographed copy.

Annual Report on the Agricultural Department, Zanzibar, for the Year 1926. Pp. 36, 9½ × 6½. (Zanzibar: Government Printer, 1927.)

Annual Report of the Department of Agriculture, Mauritius, for the Year 1926. Pp. 37,  $12\frac{1}{2} \times 8$ . (Port Louis, Mauritius: Government Printer, 1927.)

Annual Report of the Department of Scientific and Industrial Research, New Zealand, 1927. Pp. 32,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Wellington: Government Printer, 1927.) Price 9d.

Report on the Operations of the Department of Agriculture, Madras Presidency, for the Year 1926-27. Pp. 93,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1927.) Price Re.1.

Annual Reports on Agricultural Stations, Burma, for the Year ended June 30, 1927. Akyab and Kyaukpyu Coconut Farm, pp. 11, price As.8 (9d.). Allanmyo, pp. 16, price As.10 (11d.). Hmawbi, pp. 25, price Re.1 (1s. 6d.). Mahlaing, pp. 25, price Re.1 (1s. 6d.). Mandalay, pp. 29, price Re.1 (1s. 6d.). Mudon, pp. 7, price As.4 (5d.). Myaungmya, pp. 7, price As.5 (6d.). Padu, pp. 22, price As.12 (1s. 1d.). Pyinmana, pp. 13, price As.7 (8d.). Pwinbyu Seed Farm, pp. 8, price As.5 (6d.). Sa-aing Farm, pp. 2, price As.3 (3d.). Tatkon, pp. 11, price As.7 (8d.). Yawngwe and Agricultural Work in the Southern Shan States, pp. 17, price As.8 (9d.). (Rangoon: Superintendent, Government Printing, 1927.)

Report of the Agricultural Chemist, Burma, for the Year ended June 30, 1927. Pp. 8,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Rangoon: Superintendent, Government Printing, 1927.) Price As.4 (5d.).

Annual Report of the Agricultural Engineer, Burma, for the Year ended June 30, 1927. Pp. 3,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Rangoon: Superintendent, Government Printing, 1927.) Price As.2 (2d.).

Report of the Economic Botanist, Burma, for the Year ended June 30, 1927. Pp. 8,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Rangoon: Superintendent, Government Printing, 1927.) Price As.4 (5d.).

Annual Report of the Principal, Agricultural College and Research Institute, Mandalay, for the Year ended June 30, 1927. Pp. 10,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Rangoon: Superintendent, Government Printing, 1927.) Price As.4 (5d.).

Fiftieth Report of the Connecticut Agricultural Experiment Station for the Year 1926. Comprising *Bulletins* 282-289, *Tobacco Station Bulletins* 7 and 8, and *Bulletins of Immediate Information*, Nos. 55-60. Pp. xvii + 599 + 58 + li,  $9 \times 6$ . (New Haven: State of Connecticut, 1927.)

Forty-second Annual Report of the Maine Agricultural Experiment Station, 1926. Comprising *Bulletins* 329-335 and *Official Inspections* 119-122. Pp. xiii + 297 + 88,  $9 \times 6$ . (Orono, Maine: State University, 1926.)

Forty-fifth Annual Report of the Ohio Agricultural Experiment Station for 1925-26. *Bull. No. 402 Ohio Agric. Exper. Sta.* Pp. 156,  $9 \times 6$ . (Wooster, Ohio: Experiment Station, 1927.)

List of Bulletins of the United States Agricultural Experiment Stations for the Calendar Years 1925 and 1926. *Supp. 3, Dept. Bull. No. 1199, U.S. Dept. Agric.* Pp. 62,  $9 \times 5\frac{1}{2}$ . (Washington, D.C.: Government Printing Office, 1927.)

Report of the Chief of the Bureau of Agricultural Economics, United States Department of Agriculture, for the Fiscal Year ended June 30, 1927. Pp. 54,  $9 \times 6$ . (Washington, D.C.: Government Printing Office, 1927.)

Report of the Chief of the Bureau of Dairy Industry, United States Department of Agriculture, for the Fiscal Year ended June 30, 1927. Pp. 16,  $9 \times 6$ . (Washington, D.C.: Government Printing Office, 1927.)

\* Report of the Chief of the Bureau of Plant Industry, United States Department of Agriculture, for the Fiscal Year ended June 30, 1927.

**Pp. 43.** 9 × 6. (Washington, D.C.: Government Printing Office, 1927.)

Report of the Federal Horticultural Board, United States Department of Agriculture, for the Fiscal Year ended June 30, 1927. Pp. 36, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.)

Report of the Alaska Agricultural Experiment Stations, 1926. **Pp. 40,** 9½ × 6. (Washington, D.C.: Government Printing Office, 1927.)

Twenty-sixth Annual Report of the Bureau of Agriculture, Philippine Islands, for the Fiscal Year ending December 31, 1926. Pp. 102, 10 × 7. (Manila: Bureau of Printing, 1927.)

Report of the Porto Rico Agricultural Experiment Station, 1926. **Pp. 31,** 9 × 6. (Washington, D.C.: Government Printing Office, 1927.)

Neuvième Rapport de la Station Agronomique de la Guadeloupe, 1926-27. Pp. 101, 8½ × 6½. (Pointe-à-Pitre: Imp. Commerciale A. et J. Lautric, 1927.)

Rapport concernant l'Étude de la Concession de Sumba sur la Rive Gauche du Zaïre. By P. Janssens and A. A. Monteiro do Amaral. *Missão de Oleaginosas, Fomento Geral de Angola, Publ. Div. VIII.* Pp. 34, 9 × 6. (Lisbon: Agência Geral das Colónias.)

Breve Notícia sobre as Condições Agrícolas do Planalto de Malange. By J. C. Soromenho Ramão. *Missão dos Cereais, Fomento Geral de Angola, Publ. Div. IX.* Pp. 25, 9 × 6. (Lisbon: Agência Geral das Colónias.)

Verslag over de Werkzaamheden van het Besoekisch Proefstation in het jaar 1926. Med. No. 43. *Besoekisch Proefsta. (Proefsta. voor Rubber, Koffie en Tabak.)* Pp. 42, 10½ × 7½. 1927.

Manual de las Plantas Usuales de Venezuela. By H. Pittier. Pp. 458, 9½ × 6½. (Caracas, Venezuela: Litografía del Comercio, 1926.)

Agricultural Machinery and Agricultural Engineering. *Leaf. No. 8 of 1927, Dept. Agric., Bombay.* Pp. 9½ × 6. (Poona: Yeravda Prison Press, 1927.)

Agricultural Implements suitable for the Use of the Indian Cultivator. By A. P. Cliff. *Agric. Journ. India* (1927, 22, 346-350, 425-436).

Kumri Cultivation. By L. A. Natesan. *Agric. Journ. India* (1927, 22, 354-363).

Crop Improvement in Canada. By G. H. Clark. *Scottish Journ. Agric.* (1927, 10, 404-408).

The Maintenance of Crop Production on Semi-Arid Soil. By F. J. Sievers and H. F. Holtz. *Pop. Bull. No. 138, Div. Soils, Washington Agric. Exper. Sta.* Pp. 29, 9 × 6. (Pullman, Washington: State College, 1927.)

Crop Production in South-western Kansas. By E. H. Coles and F. A. Wagner. *Bull. No. 239, Kansas Agric. Exper. Sta.* Pp. 30, 9 × 6. (Manhattan, Kansas: Experiment Station, 1927.)

Work of the United States Dry-Land Field Station, Ardmore, South Dakota, 1912 to 1925. By J. S. Cole, F. L. Kelso and others. *Tech. Bull. No. 17, U.S. Dept. Agric.* Pp. 68, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 15 cents.

Ceylon Administration Reports for 1926. Part V.—Public Works (B). Report of the Director of Irrigation. Pp. 67, 12 × 8½. (Colombo: Government Record Office, 1927.) Price Re.1.40.

Irrigation in India. Review for 1925-26. *Public Works Branch, Dept. Ind. and Lab., Govt. of India.* Pp. 37, 9½ × 6½. (Simla: Government of India Press, 1927.)

Irrigation (Part IV). By A. R. C. Clifton. *Journ. Dept. Agric., W. Australia* (1927, 4, 392-402).

Behandeling van Leguminosenzaden met Zwavelzuur. By P. M. Prillwitz. *De Thee* (1926, 7, 136-143).

The Blackberry Pest. II. Distribution. III. Control. By E. F. Northcroft. *New Zealand Journ. Agric.* (1927, 35, 246-250, 369-382).  
 "Stinkblaar" (*Datura* spp.). By K. A. Lansdell. *Weeds of South Africa*, No. 18, *Bull. No. 18, Dept. Agric., Un. S. Afr.* Pp. 8, 9½ × 6. (Pretoria: Editor of Publications, Department of Agriculture, 1927.)

The Canada Thistle (*Cirsium arvensis* Linn.). By K. A. Lansdell. *Weeds of South Africa*, No. 19. *Bull. No. 19, Dept. Agric., Un. S. Afr.* Pp. 10, 9½ × 6. (Pretoria: Editor of Publications, Department of Agriculture, 1927.)

The "Mexican Poppy" (*Argemone mexicana* L.). By K. A. Lansdell. *Weeds of South Africa*, No. 20. *Bull. No. 20, Dept. Agric., Un. S. Afr.* Pp. 7, 9½ × 6. (Pretoria: Editor of Publications, Department of Agriculture, 1927.)

The Galinsoga Weed (*Galinsoga parviflora* L.). By K. A. Lansdell. *Weeds of South Africa*, No. 22. *Bull. No. 22, Dept. Agric., Un. S. Afr.* Pp. 6, 9½ × 6. (Pretoria: Government Printing Office, 1927.)

Purslane (*Portulaca oleracea* L.). By K. A. Lansdell. *Weeds of South Africa*, No. 23. *Bull. No. 23, Dept. Agric., Un. S. Afr.* Pp. 7, 9½ × 6. (Pretoria: Government Printing Office, 1927.)

### The Soil

The Conservation of Humus in Indian Soils. By C. M. Hutchinson. *Agric. Journ. India* (1927, 22, 339-345).

Cover Crops at Peradeniya in Relation to Soil Moisture. By A. W. R. Joachim and T. H. Holland. *Trop. Agric., Ceylon* (1927, 69, 261-264).

Trees and Shrubs for Producing Green Manure in the Konkan and North Kanara. By V. G. Gokhale and V. S. Habbu. Pp. 16, 9½ × 6. (Bombay: Superintendent of Government Printing, 1927.) Price As. 3 (4d.).

The Preparation and Storage of Farmyard Manure under Mauritius Conditions. By N. Craig. (English Edition). *Bull. No. 38, Gen. Ser., Dept. Agric., Mauritius*. Pp. 22, 9½ × 6. (Port Louis, Mauritius: Government Printer, 1927.)

Comparative Grazing Trials on Top-dressed Pastures. Milvale, Parkes, and Milbrulong Districts. By J. N. Whittet. *Agric. Gaz., N.S.W.* (1927, 38, 891-899).

Report of the Chief of the Bureau of Soils, United States Department of Agriculture, for the Fiscal Year ended June 30, 1927. Pp. 8, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.)

Fertilizers and Cover Crops on Soils in the Irrigated Orchards of Washington. By O. M. Morris. *Bull. No. 217, Div. Horticulture, Washington Agric. Exper. Sta.* Pp. 37, 9 × 6. (Pullman, Washington: State College, 1927.)

Verslag van de bemestingsproeven, bij de inlandsche cultures in Nederlandsch-Indië in de jaren 1920 t/m 1926 genomen, uitgezonderd groenbemestingsproeven. By A. Wulff. *Med. No. 25, Alg. Proefsta. v.d. Landbouw, Dept. Landb., Nijver. en Handel*. Pp. 378, 9½ × 6½. (Buitenzorg: Archipel Drukkerij, 1927.)

"Edelmist." By A. Cunningham. *Scottish Journ. Agric.* (1927, 10, 434-438).

### Pests—General

Report of the Entomologist, Burma, for the Year ended June 30, 1927. Pp. 9, 9½ × 6½. (Rangoon: Superintendent, Government Printing, 1927.) Price As. 4 (5d.).

The Locust Attack of 1926-27 in Sind, Kathiawar and Gujarat. By H. H. Mann and W. Burns. *Agric. Journ. India* (1927, 22, 325-332).

Notes on Termites in the Gold Coast. By W. H. Patterson. *Bull. No. 7, Dept. Agric., Gold Coast* (Year Book, 1926). Pp. 35-39.

Records of Australian Thysanoptera (Thrips). Part II. By A. A. Girault. *Queensland Agric. Journ.* (1927, 28, 348-352).

Report of the Entomologist, United States Department of Agriculture, for the Fiscal Year ended June 30, 1927. Pp. 29, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.)

Summer Chinch Bug Control. By L. Haseman. *Agric. Ext. Serv. Circ. No. 176, Missouri Coll. Agric.* Pp. 4, 9 × 6. (Columbia, Missouri: College of Agriculture, 1926.)

A New Parasite of *Heliothrips rubrocincta*. By G. S. Cotterell. *Bull. No. 7, Dept. Agric., Gold Coast* (Year Book, 1926). Pp. 47-48.

The Larger Sod Webworm. By G. G. Ainslie. *Tech. Bull. No. 31, U.S. Dept. Agric.* Pp. 18, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

The Magpie in Relation to Agriculture. By E. R. Kalmbach. *Tech. Bull. No. 24, U.S. Dept. Agric.* Pp. 30, 9½ × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 10 cents.

Injurious Field Rats of Lower Sind and their Extermination. Part I by P. V. Wagle, Part II by Khan Bahadur Gul Mahomed A. R. *Bull. No. 138 of 1927, Dept. Agric., Bombay*. Pp. 33, 9½ × 6. (Bombay: Superintendent of Government Printing, 1927.) Price As.7.6 (10d.).

Report of the Insecticide and Fungicide Board, United States Department of Agriculture, for the Fiscal Year ended June 30, 1927. Pp. 8, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.)

Le Pyrèthre Insecticide. *Bull. de l'Ag. Gén. des Col.* (1927, 20, 1279-1285).

Derris als Insecticide. By A. Kelsall, J. P. Spittall, R. P. Gorham and G. P. Walker. *De Indische Culturen (Teysmannia)* (1927, 12, 914-915).

"Natural Control" of Weeds and Insects by Fungi. By G. H. Cunningham. *Bull. No. 132, New Zealand Dept. Agric.* Pp. 8, 9½ × 9. (Wellington: Government Printer, 1927.)

Gegevens over sabelsprinkhamen als cocosvijanden in Nederlandsch-Indië en hunne parasieten. By S. Leefmans (with a summary in English). *Med. No. 72, Inst. voor Plantenziekten, Dept. Landb., Nijver. en Handel*. Pp. 95 + 14 plates, 9½ × 6½. (Weltevreden: Landsdrukkerij, 1927.) Price fl.2.75.

#### Diseases—General

Report of the Mycologist, Burma, for the Year ended June 30, 1927. Pp. 11, 9½ × 6½. (Rangoon: Superintendent, Government Printing, 1927.) Price As.4 (5d.).

Dry-rot of Swedes and Turnips: Its Cause and Control. By G. H. Cunningham. *Bull. No. 133, New Zealand Dept. Agric.* Pp. 51, 9½ × 6. (Wellington: Government Printer, 1927.)

Ziekten en plagen der cultuurgewassen in Nederlandsch-Indië in 1926. By S. Leefmans. *Med. No. 73, Inst. voor Plantenziekten, Dept. Landb., Nijver. en Handel*. Pp. 60, 9½ × 6½. (Weltevreden: Landsdrukkerij, 1927.) Price fl.0.90.

#### Foodstuffs—General

Methods of Cultivation and Uses of the Food Crops of the Gold Coast. By E. M. Cook. *Bull. No. 7, Dept. Agric., Gold Coast* (Year Book, 1926). Pp. 68-75.



De Samenstelling van de Belangrijkste Plantaardige Voedingsmiddelen van Nederlandsch-Indië. By C. van Rossem. (With a summary in English.) No. 24, *Med. Alg. Proef. v.d. Landbouw, Dept. Landb., Nijver. en Handel*. Pp. 76, 9½ × 6½. (Weltevreden: Landsdrukkerij, 1927.)

### Beverages

Experiments in Cacao Fermentation. By T. H. Holland. *Bull. No. 80, Dept. Agric., Ceylon*. Pp. 21, 8½ × 5½. (Colombo: Government Printer, 1927.) Price 40 cents.

Kostarika, ein neues Kakaoland. *Gordian* (1927, 33, 6379-6381).

Life History and Habits, etc., of *Sahlbergella singularis* Hagl. and *Sahlbergella theobroma* Dist. By G. S. Cotterell. *Bull. No. 7, Dept. Agric., Gold Coast (Year Book, 1926)*. Pp. 40-43.

A New Parasite of *Sahlbergella singularis* Hagl. By G. S. Cotterell. *Bull. No. 7, Dept. Agric., Gold Coast (Year Book, 1926)*. Pp. 44-46.

Report of Proceedings of Coffee Conference, Kenya, 1927. Pp. 29, 9½ × 6½. (Nairobi: Government Printer, 1927.)

La Coltivazione del Caffè nella Repubblica di Costarica. By Enea Razeto. *Agricolt. Col.* (1927, 21, 421-428).

De Kamferboom als Schaduwbom voor de Koffiestruik in Annam. By E. Leblanc. *De Indische Culturen (Teysmannia)* (1927, 12, 932).

The Field Experiments at Tocklai. No. 4. The Plucking Experiment. By E. A. Andrews. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1927, Part III, pp. 101-114).

Le Thé aux Indes Néerlandaises. By J. Goubeaux. *Bull. Econ. Indochine* (1927, 30, 601-641).

Vegetable Parasites of the Tea Plant. The Blights. By A. C. Tunstall. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1927, Part III, pp. 73-86).

Het Determineren der Wortelschimmels van de Thee. By A. Steinmann. *De Thee* (1926, 7, 158-164).

Over het Optreden van de Grijze Dadapschimmel en Andere op Thee Voorkomende *Septobasidium*-Soorten. By A. Steinmann. *De Thee* (1926, 7, 156-158).

Euphorus als Helopeltis-Parasiet in Afrika. By R. Menzel. *De Thee* (1926, 7, 150-153).

*Sasakiaspis pentagona* (Targ.) een veel Voorkomende Schildluis op Thee. By P. M. Prillwitz. *De Thee* (1926, 7, 164-168).

Iets over Theemachines. By J. J. B. Deuss. *De Thee* (1926, 7, 170-177.)

### Cereals

Productiveness of Certain Varieties of Corn in Illinois. By G. H. Dungan and W. L. Burlison. *Bull. No. 294, Illinois Agric. Exper. Sta.* Pp. 13, 9 × 6. (Urbana, Illinois: Experiment Station, 1927.)

The Reproductiveness of Corn as Influenced by the Mosaic Disease. By H. F. Stoneberg. *Tech. Bull. No. 10, U.S. Dept. Agric.* Pp. 19, 9 × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

The Effect of Carbon Bisulphide on the Germination of Maize. By A. R. Saunders and R. Owen Wahl. *Bull. No. 28, Dept. Agric., Un. S. Afr.* Pp. 4, 9½ × 6½, 1927.

The Life History of *Exeristes roborator* Fab., a Parasite of the European Corn Borer. By J. H. Fox. *Rept. No. 21, Nat. Res. Council, Canada*. Pp. 58 + 14 plates, 9½ × 6½. (Ottawa: King's Printer, 1927.)

**The European Corn Borer: Its Present Status and Methods of Control.** By D. J. Caffrey and L. H. Worthley. *Farm. Bull. No. 1548, U.S. Dept. Agric.* Pp. 48, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 20 cents.

**Status of Imported Parasites of the European Corn Borer.** By D. W. Jones and D. J. Caffrey. *Circ. No. 14, U.S. Dept. Agric.* Pp. 8, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

***Pennisetum typhoideum*: Studies on the Bajri Crop.** 1. The Morphology of *Pennisetum typhoideum*. By S. V. Godbole. *Mem. Dept. Agric., India, Bot. Ser.* (1927, 14, 247-268).

**Annual Report of the Paddy Breeding Station, Coimbatore, for the year 1926-27.** By R. O. Iliffe. Pp. 22, 9½ × 6. (Madras: Superintendent, Government Press, 1927.)

**Annual Report of the Paddy Breeding Station, Maruteru, for the year 1926-27.** By R. O. Iliffe and C. R. Srinivasan. Pp. 31, 9½ × 6. (Madras: Superintendent, Government Press, 1927.)

**Rice in Burma, Production, Trade and Improvement.** By D. Hendry. *Trop. Agric., W.I.* (1928, 5, 12-15).

**The Kolamba Rice of the North Konkan and its Improvement by Selection.** By R. K. Bhide and S. G. Bhalerao. *Mem. Dept. Agric. India, Bot. Ser.* (1927, 14, 199-245).

**Paddy Notes (2).** (a) The Preliminary Testing of Pure-line Selections of Rice. (b) An Account of Two Cultural Experiments. By L. Lord. *Trop. Agric., Ceylon* (1927, 69, 329-335).

**The Dicky Rice Weevil (*Maleuterpes (Prosayleus) phytolymus*)** Oliff. By A. R. Woodhill and S. L. Allman. *Agric. Gaz., N.S.W.* (1927, 38, 791-799).

**Testing of New Zealand-grown Wheats. Results for Years 1926 and 1927. II. Quality of Flours.** By F. J. A. Brogan. *New Zealand Journ. Agric.* (1927, 35, 289-294).

**Ten Years' Progress in Wheat Growing.** By A. J. Perkins. *Journ. Dept. Agric., S. Australia* (1927, 31, 240-253).

**Dry-Farming Methods and Practices in Wheat Growing in the Columbia and Snake River Basins.** By B. Hunter. *Farm. Bull. No. 1545, U.S. Dept. Agric.* Pp. 22, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 10 cents.

**Wheat Grading. A Criticism of the F.A.Q. System.** By E. Harris. *Agric. Gaz., N.S.W.* (1927, 38, 885-890).

**Varieties of Wheat in Relation to Soils and Rainfall.** By E. S. Clayton and J. T. Pridham. *Agric. Gaz., N.S.W.* (1927, 38, 753-756).

**Comparative Study of Winter Hardiness in Wheat.** By J. H. Martin. *Journ. Agric. Res.* (1927, 35, 493-535).

**Soil Factors Influencing the Development of the Mosaic Disease in Winter Wheat.** By R. W. Webb. *Journ. Agric. Res.* (1927, 35, 587-614).

### Sugar

**Weevil Borer of Cane. How to Breed the Tachinid Parasite of the "Weevil Borer" of Sugar-Cane.** By E. Jarvis. *Trop. Agric., W.I.* (1927, 4, 203-205).

**The Mosaic Disease of Sugar Cane.** By G. M. Reyes. *Philippine Agric. Rev.* (1927, 20, 187-228).

**A Report on an Investigation into the Desiccation of Sugar Beet and the Extraction of Sugar with a note on The Treatment of Sugar Beet Effluents.** By B. J. Owen. Pp. 84, 9½ × 6. (London Stationery Office, 1927.) Price 2s. 6d.

*Root Crops*

The Jerusalem Artichoke as a Crop Plant. By D. N. Shoemaker. *Tech. Bull. No. 33, U.S. Dept. Agric.* Pp. 32, 9½ × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

Improving the Sweet Potato Crop. By J. Douglass. *Agric. Gaz., N.S.W.* (1927, 38, 858-860).

El Cultivo de los Nombres. By Ignacio L. Torres. *Rev. Agric., Puerto Rico* (1927, 10, 246-247, 262).

*Fruits*

Report on the Question of Establishing Fruit Growing for Export in Sierra Leone. By M. T. Dawe. Pp. 106, 13½ × 8½. (London: Crown Agents for the Colonies, 1927.) Price 2s. 6d.

Preservation of Whole Fruit with Sulphur Dioxide. By J. M. Arthur and M. S. Benjamin. *Agric. Gaz., N.S.W.* (1927, 38, 873-875).

La Production de Fruits à Madagascar. By E. François. *Rev. Bot. App. et d'Agric. Col.* (1927, 7, 713-724).

Le Culture Legnose e le Industrie Derivate della Tunisia. [Viticulture and Olives.] By A. Ferrara. *N. 14, Relaz. e Monog. Agr. Coloniali.* Pp. 207, 9½ × 6½. (Florence: Istituto Agricolo Coloniale Italiano, 1927.)

The Codling-Moth (*Cydia pomonella* L.). Part III. By S. L. Allman. *Agric. Gaz., N.S.W.* (1927, 38, 861-872).

A Preliminary Note on a Theory as to the Origin of Bitter Pit in Apples. By W. M. Carne. *Journ. Dept. Agric., W. Australia* (1927, 4, 382-385).

Bitter Pit in Apples. Its Occurrence in Store in Relation to Dates of Picking. By G. W. Wickens and W. M. Carne. *Journ. Dept. Agric., W. Australia* (1927, 4, 354-357).

Apple Pollination Studies in Ohio. By F. S. Howlett. *Bull. No. 404, Ohio Agric. Exper. Sta.* Pp. 84, 9 × 6. (Wooster, Ohio: Experiment Station, 1927.)

The Relation of Scion Variety to Character of Root Growth in Apple Trees. By T. Swarbrick and R. H. Roberts. *Res. Bull. No. 78, Wisconsin Agric. Exper. Sta.* Pp. 23, 9 × 6. (Madison, Wisconsin: Experiment Station, 1927.)

The Avocado—A Valuable Fruit. By José de Leon and Felipe Padollina. *Philippine Agric. Rev.* (1927, 20, 349-359).

Citrus Fruit Growing in Rhodesia. By G. W. Marshall. *Rhodesia Agric. Journ.* (1927, 24, 1247-1278).

The Citrus Insects of Japan. By C. P. Clausen. *Tech. Bull. No. 15, U.S. Dept. Agric.* Pp. 16, 9½ × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

The Grape-Fruit. By F. A. Stockdale. *Leaf. No. 41, Dept. Agric., Ceylon.* Pp. 2, 9½ × 6. (Colombo: Government Printer, 1926.) Price 5 cents.

Control of Vine Diseases and Pests occurring in New Zealand. By J. C. Wooden. *New Zealand Journ. Agric.* (1927, 35, 298-309).

Results of Trials with Limes (*Citrus medica* var. *acida*) in the Central Province. By J. Steele. *Bull. No. 7, Dept. Agric., Gold Coast (Year Book, 1926).* Pp. 61-67.

Bud Selection in the Valencia Orange: Progeny Tests of Limb Variations. By A. D. Shamel, C. S. Pomeroy and R. E. Caryl. *Dept. Bull. No. 1483, U.S. Dept. Agric.* Pp. 38, 9 × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 15 cents.

**Recent Trials with Pineapples.** *Leaf. No. 42, Dept. Agric., Ceylon.* Pp. 4, 9½ × 6. (Colombo: Government Printer, 1926.) Price 5 cents.

**Varietal Characteristics of Plums in the Pacific States in Relation to Pruning.** By C. F. Kinman. *Dept. Bull. No. 1477, U.S. Dept. Agric.* Pp. 38 + 39 plates, 9½ × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 45 cents.

**Tests of Methods for the Commercial Standardization of Raisins.** By E. M. Chace and C. G. Church. *Tech. Bull. No. 1, U.S. Dept. Agric.* Pp. 24, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

**Irish Blight of Tomatoes.** By J. H. Simmonds. *Queensland Agric. Journ.* (1927, 28, 453-455).

**Walnut Drying and Packing in Oregon.** By E. H. Wiegand. *Sta. Bull. 227, Oregon Agric. Coll. Exper. Sta.* Pp. 28, 9 × 6. (Corvallis, Oregon: Oregon Agricultural College Experiment Station, 1927.)

### Spices

**La Vanille au Mexique.** *La Parfumerie Moderne* (1927, 19, 278-280).

### Fodders and Forage Crops

**Fodder Grass Trials on the Experiment Station, Peradeniya, 1926-27.** By T. H. Holland. *Trop. Agric., Ceylon* (1927, 69, 204-207).

**Soybean Hay and Sweet-Clover Pasture for Growing Purebred Draft Fillies.** By J. L. Edmonds and C. W. Crawford. *Bull. No. 292, Illinois Agric. Exper. Sta.* Pp. 14, 9 × 6. (Urbana, Illinois: Experiment Station, 1927.)

**Relation of Maturity to the Nutritive Value of First, Second and Third Cuttings of Irrigated Alfalfa.** By J. Sotola. *Journ. Agric. Res.* (1927, 35, 361-383).

**Essentials of Alfalfa Production.** By C. E. Carter. *Circ. No. 175, Missouri Agric. Ext. Service.* Pp. 8, 8½ × 6. (Columbia, Missouri: College of Agriculture, 1926.)

**Observations on Some Alfalfa Root Troubles.** By J. L. Weimer. *Dept. Circ. No. 425, U.S. Dept. Agric.* Pp. 10, 9½ × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

**Feeding Alfalfa Hay.** By J. Sotola. *Bull. No. 220, Washington Agric. Exper. Sta.* Pp. 35, 9 × 6. (Pullman, Washington: State College, 1927.)

**Alfalfa Production in Kansas.** By R. I. Throckmorton and S. C. Salmon. *Bull. No. 242, Kansas Agric. Exper. Sta.* Pp. 42, 9 × 6. (Manhattan, Kansas: Experiment Station, 1927.)

**An Experimental Study of Sweet Clover.** By C. J. Willard. *Bull. No. 405, Ohio Agric. Exper. Sta.* Pp. 84, 9 × 6. (Wooster, Ohio: Experiment Station, 1927.)

**Sweet Clover in Missouri.** By C. E. Carter. *Agric. Ext. Serv. Circ. No. 179, Missouri Coll. Agric.* Pp. 8, 9 × 6. (Columbia, Missouri: College of Agriculture, 1926.)

**Efwatakala Grass (*Melinis minutiflora*) Trials at Kumasi Agricultural Station.** By T. Hunter. *Bull. No. 7, Dept. Agric., Gold Coast (Year Book, 1926).* Pp. 49-50.

**Studies of the Influence of Menhaden-Fish Meal on Calcification in Growing Animals.** By L. A. Maynard and R. C. Miller. *Mem. No. 108, Cornell Agric. Exper. Sta.* Pp. 23, 9 × 6½. (Ithaca, New York: Cornell University, 1927.)

**Rape-Manuring Experiments in Canterbury, Season 1926-27.** By A. W. Hudson. *New Zealand Journ. Agric.* (1927, 35, 386-393).

Experiments on the Feeding of Sorghum Silage and Concentrate to Scindi Calves. By F. J. Warth and Shari Kant Misra. *Mem. Dept. Agric., India., Chem. Ser.* (1927, 9, No. 5, pp. 125-153). Price As.9 (10d.)

Sudan Grass (*Andropogon sorghum*). By G. K. Baron-Hay. *Journ. Dept. Agric., W. Australia* (1927, 4, 410-417).

The Composition of Swedes. By A. Lauder. *Scottish Journ. Agric.* (1927, 10, 428-433).

A Technical Study of the Digestibility of Corn Stover Silage for Beef Cows. By T. S. Hamilton and H. P. Rusk. *Bull. No. 291, Illinois Agric. Exper. Sta.* Pp. 18, 9 x 6. (Urbana, Illinois: Experiment Station, 1927.)

#### Oils and Oil Seeds

Huiles de Graines de Baobabs (*Adansonia* L.—Bombacées). By F. Heim de Balsac, G. S. Dagand and H. Heim de Balsac. *Bull. de l'Ag. Gén. des Col.* (1927, 20, 983-990).

Ceylon's Coconut Crops. By F. A. Stockdale. *Trop. Agric., Ceylon* (1927, 69, 325-328).

Abnormalities in the Coconut Palm. By W. N. Sands. *Malayan Agric. Journ.* (1927, 15, 290-293).

A Note on the Methods of Destroying Dead Coconut Palms. By F. R. Mason. *Malayan Agric. Journ.* (1927, 15, 294-296).

Die Erdnuss in den Südstaaten von Nordamerika. By J. C. Th. Uphof. *Der Tropenpflanzer* (1927, 30, 475-480).

The Effects of Cultivation on Wild Oil-Palms in the Western Province, Gold Coast. By C. Saunders. *Bull. No. 7, Dept. Agric., Gold Coast (Year Book, 1926).* Pp. 12-16.

The Oil Palm in Malaya. By B. Bunting, B. J. Eaton and C. D. V. Georgi. *Malayan Agric. Journ.* (1927, 15, Nos. 9-10, pp. 303-386).

La Situation de la culture du Palmier à Huile sur la côte orientale de Sumatra et dans la province d'Atjeh. By M. A. Luytjes. *Bull. Matières Grasses, Inst. Col., Marseille* (1927, No. 12, pp. 317-339).

Notes on the Structure and Classification of Oil-Palm Fruits. By G. G. Auchinleck. *Bull. No. 7, Dept. Agric., Gold Coast (Year Book, 1926).* Pp. 20-22.

#### Essential Oils

Annual Report on Essential Oils, Synthetic Perfumes, etc. English Edition, 1926. Pp. 247, 8½ x 6. (Miltitz, near Leipzig: Schimmel & Co., 1926.)

Les Citronnelles. By C. Chalot. *La Parfumerie Moderne* (1927, 19, 275-277).

Le Patchouli. By C. Chalot. *Agron. Col.* (1927, 16, 353-358).

Le Vétiver. By C. Chalot. *Agron. Col.* (1927, 16, 331-336).

#### Fibres

Cultivation of Kapok. *Trop. Agric., Ceylon* (1927, 69, 305-309).

Studies of the Occurrence and Elimination of Kemp Fibres in Mohair Fleeces. By J. I. Hardy. *Tech. Bull. No. 35, U.S. Dept. Agric.* Pp. 16, 9 x 6. (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

Rosella, *Hibiscus sabdariffa* Perrot. By A. Langer. *De Indische Culturen (Teysmannia)* (1927, 12, 873-879).

Report of Sericultural Operations, Burma, for the Year ended

June 30, 1927. Pp. 7. 9½ × 6½. (Rangoon: Superintendent, Government Printing, 1927.) Price As. 3 (3d.).

Report on the Accra Sisal Plantation. By J. M. Wingate. *Bull. No. 7, Dept. Agric., Gold Coast (Year Book, 1926)*. Pp. 51-55.

Notos sobre las Plantas Textiles, con referencia especial a la Industria del Sisal. By A. Wigglesworth. *El Henequenero* (1927, 1, 158-164).

El Departamento de Agricultura de Washington y la clasificación del Henequén. By Antonio Ancona Perez. *El Henequenero* (1927, 1, 107-108, 129-130, 153-154, 178-179, 200-204, 218-219).

El Cultivo del Sisal en las Indias Neerlandesas. By H. Ross. *El Henequenero* (1927, 1, 197-199).

Estudio Práctico sobre los Aparatos para desespinar las Hojas del Henequen. By José A. Bolio. *El Henequenero* (1927, 1, 131-134).

### Cotton

Research in the Cotton Industry. A Review of the Work of the British Cotton Industry Research Association up to the End of 1926. Pp. 80, 9½ × 6. (Didsbury, Manchester: British Cotton Industry Research Association, 1927.) Price 5s.

Memorandum on Cotton. *Publications of the League of Nations, II. Economic and Financial* (1927, 2, No. 1). Pp. 78, 10½ × 8. (Geneva: League of Nations, 1927.) Price 3s.

The Effect of Temperature and Humidity on Cotton Spinning, with particular Reference to Conditions in Bombay. By A. J. Turner. *Bull. No. 9, Tech. Ser. No. 4, Indian Central Cotton Committee Technological Laboratory*. Pp. 46, 13½ × 8½. (Bombay: The Times Press, 1927.) Price Rs. 2.

The Effect of Subjecting Cotton to Repeated Blow-Room Treatment. By A. J. Turner. *Bull. No. 10, Tech. Ser. No. 5, Indian Central Cotton Committee Technological Laboratory*. Pp. 23, 13½ × 8½. (Bombay: The Times Press, 1927.) Price Re. 1.

Technological Reports on Standard Indian Cottons, 1927. By A. J. Turner. *Bull. No. 11, Tech. Ser. No. 6, Indian Central Cotton Committee Technological Laboratory*. Pp. 116, 13½ × 8½. (Bombay: The Times Press, 1927.) Price Rs. 2.

Experiments on Cotton Manuring in Khandesh. By K. M. Pawar and N. G. Apte. *Bull. 143 of 1927, Dept. Agric., Bombay*. Pp. 7, 9½ × 6. (Bombay: Superintendent of Government Printing, 1927.) Price As. 1-3 (2d.).

Cotton Growing in Queensland. Part I. Cotton Cultivation. By W. G. Wells. *Queensland Agric. Journ.* (1927, 28, 459-485).

Cotton Growing in Queensland. Part II. Pests of Cotton in Queensland. By E. Ballard. *Queensland Agric. Journ.* (1927, 28, 589-613).

Report on Cotton Selection Work in British Togoland, Dec., 1925-Feb., 1926. By F. N. Howes. *Bull. No. 7, Dept. Agric., Gold Coast (Year Book, 1926)*. Pp. 76-88.

Acala Cotton, A Superior Upland Variety from Southern Mexico. By O. F. Cook and C. B. Doyle. *Circ. No. 2, U.S. Dept. Agric.* Pp. 30, 9 × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 20 cents.

The Establishment of Standard Grades for American Cotton Linters. By G. S. Meloy. *Misc. Pub. No. 10, U.S. Dept. Agric.* Pp. 8, 9 × 5½. (Washington, D.C.: Government Printing Office, 1927.)

Die Baumwollversuchsstation in Adana, ihr Zweck und ihre Ziele. By A. Marcus. *Der Tropenpflanzer* (1927, 30, 426-432).

## 116 BULLETIN OF THE IMPERIAL INSTITUTE

Parasites of the Pink Bollworm in Hawaii. By H. F. ~~Winters~~. *Tech. Bull. No. 19, U.S. Dept. Agric.* Pp. 16, 9 × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

### Paper-making Materials

Paper Pulp from Australian Timbers. By L. R. Benjamin. *Journ. Council Sci. and Indust. Res., Australia* (1927, 1, 65-73).

The National and Imperial Importance of the Bamboo Pulp Industry. *Indian Forester* (1927, 53, 679-683).

Die Zellstoffgewinnung mit Hilfe des Chlors und ihre Anwendung auf tropische Hölzer. By W. Gierisch. *Der Tropenpflanzer* (1927, 30, 467-472).

### Rubber

Recent Work in the East on the Relations between Stock and Scion in Budding and Grafting. By G. G. Auchinleck. *Bull. No. 7, Dept. Agric., Gold Coast (Year Book, 1926)*. Pp. 89-94.

Le Caoutchouc à Sumatra (Indes Néerlandaises). By C. Huffmann. *Bull. Agric. Congo Belge* (1927, 18, 155-201).

Studies on Hevea Latex. VII.—Rubber Derived from Preserved Latex. By R. O. Bishop. *Malayan Agric. Journ.* (1927, 15, 271-282).

Variation in Plantation Rubber. By B. J. Eaton and R. O. Bishop. *Malayan Agric. Journ.* (1927, 15, 283-289).

De Economie van natriumsilicofluoride als coagulant, II. The Economy of sodium silico-fluoride as a coagulant, II. By N. H. van Harpen. *Rubberserie No. 56, Med. Alg. Proefsta. A.V.R.O.S.* Pp. 20, 10½ × 7½. (Buitenzorg: Archipel Drukkerij, 1927.)

Latex als afleveringsvorm van rubber. Latex as a marketable grade of rubber. By H. N. Blommendaal and N. H. van Harpen. *Rubberserie No. 57, Med. Alg. Proefsta., A.V.R.O.S.* Pp. 19, 10½ × 7½. (Buitenzorg: Archipel Drukkerij, 1927.)

### Tobacco

Australian Tobacco Investigation. *Journ. Dept. Agric., S. Australia* (1927, 31, 299-300).

Types of Nyasaland-grown Tobacco. By A. J. W. Hornby and H. D. McAuslan. *Bull. No. 2, Agron. Ser., Dept. Agric., Nyasaland*. Pp. 16, 8 × 6½. (Zomba: Government Printer, 1927.) Price 1s.

Tobacco Pests of Rhodesia. By R. W. Jack. *Rhodesia Agric. Journ.* (1927, 24, 1235-1246).

Flue-curing Tobacco Barns. 12 ft. × 12 ft. × 16 ft. By B. G. Gundry. *Rhodesia Agric. Journ.* (1927, 24, 1169-1179).

Fertilizer Tests with Flue-cured Tobacco. By E. G. Moss, J. E. McMurtrey, Jr., W. M. Lunn, and J. M. Carr. *Tech. Bull. No. 12, U.S. Dept. Agric.* Pp. 59, 9 × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 15 cents.

### Drugs

La Culture du Quinquina dans la Région Ouest de Java. By G. Frontou. *Bull. Econ. Indochine* (1927, 30, 545-586).

The Toxic Constituent of Richweed or White Snakeroot (*Eupatorium urticifolium*). By J. F. Couch. *Journ. Agric. Res.* (1927, 35, 547-576).

### Miscellaneous Agricultural Products

Grass, <sup>Straw</sup>straws and Waste Vegetable Materials as possible Sources of Power Alcohol. 4th Memo., *Fuel for Motor Transport, Fuel Res.*,

*Dept. Sci. and Ind. Res.* Pp. 25, 9½ × 6. (London: Stationery Office, 1927.) Price 9d.

The Possibilities of Power Alcohol and Certain other Fuels in Australia. By G. A. Cook. *Bull. No. 33, Council Sci. and Indust. Res., Australia.* Pp. 106, 9½ × 6. (Melbourne: Government Printer, 1927.)

#### Livestock

A Survey of Poultry-Farms in British Columbia, 1921-25. By W. J. Riley, E. A. Lloyd and V. S. Asmundson. *Bull. No. 11, Coll. Agric., Bull. No. 102, Dept. Agric., Prov. of British Columbia.* Pp. 52, 10 × 6½. (Victoria B.C.: Printer to the King, 1927.)

Report of the Chief of the Bureau of Animal Industry, United States Department of Agriculture for the Fiscal Year ended June 30, 1927. Pp. 50, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.)

Report on Experiments on the Winter Feeding of Sheep at the Manor Farm, Garforth, 1925-26 and 1926-27. No. 153, *Univ. Leeds and Yorks. Council for Agric. Educ.* Pp. 30, 8½ × 5½. (Leeds: University of Leeds, 1927.)

Sheep Production in Kansas. By H. E. Reed. *Bull. No. 240, Kansas Agri. Exper. Sta.* Pp. 76, 9 × 6. (Manhattan, Kansas: Experiment Station, 1927.)

#### FORESTRY

##### General (including Timbers)

Report of Committee on the Future Forest Policy of Government and on the Formation of a Forest Trust, British Guiana. No. 6. *Combined Court, British Guiana*, 1927. Pp. 12, 13½ × 8½. (Georgetown, Demerara: Government Printers, 1927.)

Annual Report of the Forest Department, Kenya, 1926. Pp. 33, 8½ × 6½. (Nairobi: Government Press, 1927.) Price 1s.

Annual Report on the Forestry Department, Uganda Protectorate, for the Year ended December 31, 1926. Pp. 14, 13½ × 8½. (Entebbe: Government Printer, 1927.) Price 1/50 Shs.

Annual Report of The Forestry Department, Nyasaland, for the Year 1926. Pp. 15, 13½ × 8½. Supplement to *Nyasaland Government Gazette* of October 31, 1927. (Zomba, Nyasaland: Government Printer, 1927.)

Progress Report of Forest Administration in the Province of Assam for the Year 1926-27. Pp. 20 + 53, 13 × 8½. (Shillong: Government Press, 1927.) Price Re.1. (2s.).

Progress Report of the Imperial Forest College, Dehra Dun, for the Year 1926-27. Pp. 9½ × 6½. (Calcutta: Government of India Central Publication Branch, 1927.) Price Re.1 As.12 (3s.).

Annual Report of the Forest Department, Sarawak, for 1926. Supplement to *Sarawak Government Gazette*, Aug. 1, 1927, pp. 423-431. (Kuching, Sarawak: Government Printing Office, 1927.)

Report on the Operations of the Forests Department, Western Australia, for the Year ended June 30, 1927. Pp. 46, 13 × 8½. (Perth: Government Printer, 1927.)

Brief Description of Forestry in Victoria. By O. Jones. Pp. 7, 9½ × 6. (Melbourne: Forests Commission of Victoria.)

Recent Developments in Trinidad and Tobago. By R. C. Marshall. *Emp. Forestry Journ.* (1927, 6, 202-209).

Silvicultural Treatment of Mahogany Forests in British Honduras. By N. S. Stevenson. *Emp. Forestry Journ.* (1927, 6, 219-227).



American Forests and Forest Products. *Stat. Bull. No. 21, U.S. Dept. Agric.* Pp. 324, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 45 cents.

Annual Report of the Director of Forestry of the Philippine Islands for the Fiscal Year ended December 31, 1926. Pp. 292, 9 × 6. (Manila: Bureau of Printing, 1927.)

Congress Reports concerning Forestry and Forest Science in Suomi (Finland). Suomen metsätaloutta ja metsätiedettä koskevia kongressiesitelmää. (In English) *No. 4, Silva Fennica*. Pp. 90, 9½ × 6½. (Helsinki: Suomen Metsätieteellinen Seura—Finska Forstsamfundet (Society of Forestry in Finland), 1927).

Ehdotus Suomen metsätalous ja metsätieteellinen tutkimustointa. Scheme for the Development of Forest Research Work in Suomi (Finland). By L. Ilvessalo. (With English Summary.) *No. 7, Silva Fennica*. Pp. 18, 9½ × 6½. (Helsinki: Suomen Metsätieteellinen Seura—Finska Forstsamfundet (Society of Forestry in Finland), 1927).

Economics of Forestry. Some Evidences of Specialisation. By A. V. Galbraith. Pp. 4, 9½ × 6. (Melbourne: Forests Commission of Victoria, 1926.)

Trees in Roads and Streets: their Establishment and Maintenance. By W. Dallimore. *Quart. Journ. Forestry* (1928, 22, 19–28).

Farm Forestry. I. The Uses of Trees on Farm and Pastoral Areas. By R. H. Anderson. *Agric. Gaz., N.S.W.* (1927, 33, 733–747).

Farm Forestry. II. Principles of Tree Planting. By R. H. Anderson. *Agric. Gaz., N.S.W.* (1927, 33, 835–841, 909–919).

Hedges and Shelter-Trees for Homestead and Farm. By W. C. Hyde. *Bull. No. 131, New Zealand Dept. Agric.* Pp. 7, 9½ × 6½. (Wellington: Government Printer, 1927.)

Le Ravenala. By H. Jumelle. *Agron. Col.* (1927, 16, 321–330).

Forest Fires: Cause and Effect. Remedial and Control Measures. By A. V. Galbraith. Pp. 4, 9½ × 6. (Melbourne: Forests Commission of Victoria, 1926.)

Chafer Beetles. *Leaflet No. 17, Forestry Commission*. Pp. 6, 9½ × 6. (London: Forestry Commission, 1927.) Gratis.

The Pine Tip Moth in the Nebraska National Forest. By S. A. Graham and L. G. Baumhofer. *Journ. Agric. Res.* (1927, 35, 323–333).

The Gum-Tree Weevil and its Parasites. Preliminary Control Work in New Zealand. By D. Miller. *New Zealand Journ. Agric.* (1927, 35, 283–289).

Tests of Pit Props: A comparison of the Mechanical and other Properties of various species of Timber grown in the United Kingdom and cut as Pit Props, as well as of imported Pit Props. *Parts I and II, Progress Report No. 2, Project No. 2, For. Prod. Res. Lab., Princes Risborough, Dept. Sci. and Indust. Res.* Pp. 42, 9½ × 7½. (Princes Risborough, Bucks: Forest Products Research Laboratory, 1927.) Mimeographed copy.

The Air-seasoning and Conditioning of Timber. By F. M. Oliphant. *Spec. Rept. No. 1, Forest Prod. Res., Dept. Sci. and Indust. Res.* Pp. 26, 9½ × 7½. (London: Stationery Office, 1927.) Price 2s.

Commercial Timber Trees of the Malay Peninsula. By F. W. Foxworthy. *Malayan Forest Records, No. 3*. Pp. 195, 11 × 7½. (Kuala Lumpur: Conservator of Forests, F.M.S. and S.S., 1927.) Price \$5 or 12s.

The Himalayan Silver Firs and Spruces. By R. N. Parker. *Indian Forester* (1927, 53, 683–693).

The Control of Stain, Decay, and other Seasoning Defects in Red Gum. By L. V. Teesdale. *Dept. Circ. 421, U.S. Dept. Agric.* Pp. 19, 9½ × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 10 cents.

**The Teak Industry of Siam.** By D. R. S. Bourke-Borrowes. *Tech. and Sci. Supp. No. 3, to The Record, Siam.* Pp. 52, 12½ × 8½. (Bangkok: Ministry of Commerce and Communications, 1927.) Price 3 ticals.

**Timber Growing and Logging Practice in the Central Hardwood Region.** Measures necessary to keep Forest Land productive and to produce full Timber Crops. By C. R. Tillotson and W. B. Greeley. *Dept. Bull. No. 1491, U.S. Dept. Agric.* Pp. 39, 9½ × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 15 cents.

**Timber Growing and Logging Practice in the Douglas Fir Region.** Measures necessary to keep Forest Land productive and to produce full Timber Crops. By T. T. Munger and W. B. Greeley. *Dept. Bull. No. 1493, U.S. Dept. Agric.* Pp. 42, 9½ × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 15 cents.

**Timber Growing and Logging Practice in the Western White Pine and Larch-Fir Forests of the Northern Rocky Mountains.** Measures necessary to keep Forest Land productive and to produce full Timber Crops. By E. Koch and R. N. Cunningham. *Dept. Bull. No. 1494, U.S. Dept. Agric.* Pp. 38, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 15 cents.

**Shortleaf Pine Primer.** By W. R. Mattoon. *Farm. Bull. No. 1534, U.S. Dept. Agric.* Pp. 42, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 10 cents.

**Defects in Timber caused by Insects.** By T. E. Snyder. *Dept. Bull. No. 1490, U.S. Dept. Agric.* Pp. 47, 9½ × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 15 cents.

#### *Tanning Materials*

**Aperçu sur les Plantes Tannifères du Maroc.** By E. Miège. *Bull. Soc. d'Encour. pour l'Indust. Nat.* (1927, 128, 645-662).

**Contribution à l'Étude des Écorces Tannifères de Madagascar. II. Écorce de Badamier (*Terminalia Catappa* L., Combrétacées).** By F. Heim de Balsac, A. Deforge, J. Maheu and H. Heim de Balsac. *Bull. de l'Ag. Gén. des Col.* (1927, 20, 969-983).

**Les Écorces de *Melaleuca* (Myrtacées): "Niaouli" de Nouvelle-Calédonie, "Tram" de Cochinchine, "Smach" du Cambodge.** By F. Heim de Balsac, G. S. Dagand, A. Deforge and H. Heim de Balsac. *Bull. de l'Ag. Gén. des Col.* (1927, 20, 1289-1310).

#### *Gums and Resins*

**Report on the Kauri-Gum Industry for the Year ended March 31, 1926.** Pp. 6, 13½ × 8½. (Wellington: Government Printer, 1926.) Price 6d.

**Notes on Damar Penak.** By R. W. Blair and F. E. Byron. *No. 4. Malayan For. Records.* Pp. 12, 10½ × 7. (Kuala Lumpur: Conservator of Forests, F.M.S. and S.S., 1927.) Price \$0.50 (1s.).

**Production of Gutta-Percha, Balata, Chicle and Allied Gums.** By J. W. Vander Laan. *Trade Prom. Ser. No. 41, U.S. Dept. Comm.* Pp. 72, 9½ × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 15 cents.

## NOTICES OF RECENT LITERATURE

DER FLACHS ALS FASER- UND ÖLPFLANZE. Edited by Professor Dr. Fr. Tobler. Pp. vi + 273, 9 × 6. (Berlin: Verlag von Julius Springer, 1928.) Price RM.19.50.

The author has prepared this book with the object of giving an up-to-date account of flax production in both its scientific and practical aspects. His long experience of questions relating to flax cultivation and the work he has carried out on problems in this sphere during the many years in which he has acted as Director of the Sorau Research Institute are a guarantee of the excellence of his book. Some portions of the work he entrusted to well-known collaborators, including Prof. Dr. G. Brede-mann, who contributes a chapter on the breeding and selection of flax plants, Prof. Dr. K. Opitz, who deals with the practical agricultural side, and Dr. E. Schilling, who has prepared the chapters on the pests, diseases and weeds by which flax areas are liable to be infested, as well as those on linseed and its oil and cake.

The book forms an excellent monograph on flax in all its aspects, including the plant, its form, occurrence, histological structure, the cultivation and harvesting of the crop for both fibre and seed, the methods of flax retting and preparation, and the production and utilisation of linseed.

The work is well illustrated, is furnished with a useful bibliography, and forms one of the most complete accounts of flax hitherto published.

A TEA MANUAL FOR BEGINNERS. By J. W. S. Pp. xii + 128, 8½ × 5½. (Colombo: The Ceylon Advertising Co., Ltd., 1926.) Price Rs.7.50.

This is a practical guide to the tea industry from the standpoint of the producer, and has been written in the hope that planters consulting it may be able to avoid blunders which might arise from lack of knowledge of the details of planting practice. The author concisely describes the requirements of the tea plant as regards climate, situation, soil, etc., the operations necessary to prepare the land for a tea plantation, the proper treatment of the plants and the plucking of the leaves, and the various operations involved in the manufacture of tea for the market. Useful observations, with special reference to Ceylon conditions, are also offered regarding the management of native labour on tea estates. The book should prove useful to intending

tea planters and to those whose experience is insufficient to ensure the best results.

**ECONOMIC ASPECTS OF CANE SUGAR PRODUCTION.** By Francis Maxwell, D.Sc., M.I.Mech.E., F.C.S. Pp. vi + 199, 9½ × 6. (London: Norman Rodger, 1927.) Price 12s. 6d.

This is an interesting book on the economic features of the cane sugar industry in various countries. The author, in addition to experience both in factory and plantation in a number of the principal producing countries, recently made a world-tour of investigation lasting three years and including Mauritius, Réunion, Natal, Zululand, India, Egypt, Java, Queensland, Hawaii and Cuba. Dr. Maxwell's aim was not to deal exhaustively with the economic basis of the sugar industry but to treat of certain aspects which specially attracted his attention in comparing the conditions of the industry in different lands. The subjects dealt with comprise the characteristic features of the leading cane sugar countries, cane varieties, the quality of the cane in different countries, yields of cane and sugar per acre, the labour question, costs of production, sugar factories, the manufacture of white sugar, experiment stations and organisation. In an appendix are shown specimen contracts of different countries between the estate and the factory. The book throughout is well illustrated.

**ORCHARDING.** By Victor Ray Gardner, Frederick Charles Bradford and Henry Daggett Hooker. Pp. xi + 311, 9 × 5½. (London: McGraw-Hill Publishing Co., Ltd., 1927.) Price 15s.

This book, which is intended for beginners in the study of fruit-growing, aims at presenting a general survey of the subject, leaving for further study such special problems as relate to particular conditions or localities. While full weight is given to the scientific principles underlying the art of fruit-growing, stress is laid upon the fact that practice must be determined not only by the trend of scientific discovery but also by changes in economic conditions, which are deciding factors of considerable importance.

The information given in the book supplies a comprehensive introduction to the principles of orchard practice and should serve as an incentive to further study. The concluding chapters introduce the subject of fruit marketing and the business side of fruit production generally, and will indicate to the intending orchardist the lines on which his economic problems will have to be faced.

**THE GOLD COAST FOREST : A STUDY IN SYNECOLOGY.**  
By T. F. Chipp, M.C., Ph.D. Oxford Forestry Memoirs,  
Number 7, 1927. Pp. 94, 11 × 7½. (Oxford: The  
Clarendon Press, 1927.)

This work is the first general attempt to present the main facts of the ecology of the forest region of the Gold Coast which comprises an area of nearly 30,000 square miles. A considerable volume of knowledge has accumulated with regard to the floristic conditions of the region, and progress in this direction has been particularly marked during the last fifteen or twenty years, largely as a consequence of the increased possibilities of travel resulting from the more settled state of the country. Not only has there been an expansion in the knowledge of the flora, but a corresponding advance has been made in the study of plant distribution within the forest. Concurrently, much information has been collected in another but closely related field, that of climatology, chiefly as the outcome of the observations of Dr. C. E. P. Brooks and M. Hubert. A desideratum therefore has been an ecological study of the forests, which is all the more urgent in view of the rate at which the natural vegetation of the country is changing with economic development. Information on this subject has hitherto been limited, the ecological treatment of much of Thompson's "Report on Forests, Gold Coast" and the conclusions to be drawn from the extensive field observations of Dr. A. Chevalier on the West African flora being the only contributions to this important aspect of the subject. It became apparent that if any further advance were to be made in the study of the forest region it was necessary to ascertain the units of vegetation composing the forest and to work out their characteristics, the factors controlling them, and the scheme under which the several units are joined to form the forest as a whole.

Dr. Chipp's investigations, as recorded and discussed in the present work, make a valuable contribution to the desired knowledge. His travels in the country are shown in a sketch map which indicates the thorough traversing which is essential to obtaining a satisfactory knowledge of a regional flora. It is not possible here to follow in detail the account presented by the author and it will be sufficient to mention that his study of the climatology of the country, based on abundant local statistics, has enabled him to determine a "climatic unit" whose factors exercise a controlling influence over the forest. It has thus been possible to recognise the principal units of vegetation and to determine the structural basis of the forest as a whole; while the general lines of successive development in

the chief types of vegetation have also been worked out. The concluding part of the work deals with the interesting problems of plant form, including the variation in form of the same species growing under different conditions of environment and the not less important retention of the same form under very dissimilar environments. This part, moreover, contains the first account of "plant indicators" of the Gold Coast vegetation. The itinerary is given of a march from Kumasi southward to Tarkwa, during which a record was made of the "vegetation types" of the successive sections of the journey and the principal indicators (outstanding characteristic species) of these types.

**FARM SOILS: THEIR MANAGEMENT AND FERTILIZATION.** By Edmund L. Worthens, M.S. Pp. x + 410, 8 × 5½. (New York: John Wiley and Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 13s. 6d.

For the successful production of crops it is necessary not only to have a knowledge of plant nutrition and manuring but also to understand something of the nature of the soil itself and the best methods of using and conserving its resources. The main purpose of this book is to supply to farmers and to students of agricultural problems the information on which this science of "soil management" is based, together with practical instructions for putting such knowledge into effect.

The principles of manuring are dealt with and some account of the food requirements of crops is given, but the book as a whole is written from the standpoint of making the most of the soil rather than from that of raising particular crops. Thus there is a chapter on the control of water supply, one is devoted to various agricultural operations, and others deal with liming and the methods of using different classes of manures and fertilisers. The last four chapters are devoted to the management of field soils, pasture soils, garden and lawn soils, and fruit soils. Most of the chapters are divided into two sections headed "operations" and "general information," the latter explaining the rationale of the former.

**SOIL MANAGEMENT.** By Firman E. Bear, Ph.D. Second Edition. Pp. v + 412, 9 × 5½. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 17s. 6d.

The first edition of this work, published in 1924, was noticed in this BULLETIN (1925, 23, 129). That a new edition has been called for within three years demonstrates its usefulness. The original arrangement has been retained,

but the subject matter has been thoroughly revised and re-written. Many new illustrations have been added and not only has the number of pages been increased from 268 to 412, but the book has been entirely re-set, so that there is about 20 per cent. more matter on each page. In its enlarged form the work should be of increased value to all interested in scientific agriculture.

**GREEN MANURING : PRINCIPLES AND PRACTICE.** By Adrian J. Pieters, Ph.D. Pp. xiv + 356, 9 × 5½. (New York : John Wiley & Sons, Inc. ; London : Chapman & Hall, Ltd., 1927.) Price 22s. 6d.

The importance of green manuring in maintaining the fertility of the soil and thus assisting in overcoming the ever-increasing difficulty of increasing the food supplies is now well recognised. Few comprehensive books on the subject, however, have hitherto been available, and the present work will be welcomed by the scientific farmer and student of agriculture.

Throughout the book emphasis is laid on the general principles underlying the practice of green manuring. In view of the fact that its value is due to the addition of organic matter to the soil, the author deals in some detail with the question of the amount of such material in soils, its source and the influences which operate for its destruction or increase, in addition to the actual part it plays in the soil. The nitrogen problem of the soil is discussed, and an account given of nitrogen fixation in the soil including the question of the availability of the nitrogen in green manures. Useful tables are given showing the proportions of nitrogen, phosphoric acid and potash in various crops used as green manures and in a number of common weeds. Other matters which receive consideration include the changes which green manures undergo in the soil and the conditions which affect decomposition, the effect of green manures in improving soil tilth, and various practical considerations, such as inoculation for leguminous plants, time and depth of ploughing, effect of certain green manure crops on following crops, quantity of green matter produced per acre, etc.

As illustrating the value of green manuring, particulars are given of its effect on the yield of certain crops, including maize, cotton, potato, sugar beet, sugar cane, tobacco, vegetables and orchard crops. With regard to tobacco it is pointed out that although green manuring of this crop has been successful in the tropics, good results have not always been secured in the United States. The failure of a green manure crop to increase yields is in many

cases attributed to special conditions, which may be corrected with increasing knowledge.

A chapter of 43 pages is devoted to an account of the principal crops used as green manures, including certain tropical plants and a few non-leguminous plants and weeds. Details are given of green manuring as practised in various parts of the world and the concluding chapter discusses the financial aspects of the subject.

Although primarily written for readers in temperate regions, the book will be found of great value also to those interested in tropical crops, since the general principles discussed are mostly of world-wide application, and certain crops of the tropics, such as rubber, tea, rice and cotton, are specifically dealt with. A very useful feature of the book is the bibliography, which comprises some 350 entries.

**MANURE AND MANURING.** A Handbook for Practical Farmers, Students and others. By Frank Ewart Corrie, B.Sc., N.D.A., N.D.D. Pp. xi + 168,  $7\frac{1}{2} \times 4\frac{3}{4}$ . (London : Chapman & Hall, Ltd., 1927.) Price 5s.

This addition to the ever-growing number of handbooks on manures provides, in an eminently readable form and in a volume of convenient size, an introduction to the underlying principles of the science. It should appeal both to the farmer and also to the student approaching the subject for the first time.

The principles of plant nutrition, the sources, nature and effects of different manurial ingredients, and the manurial treatment of particular crops are briefly considered. Emphasis is laid on the necessity for keeping the soil in such a condition of fertility as will most conduce to the production of crops and the maintenance of live-stock as against the short-sighted policy of manuring simply to obtain a large return from a particular crop.

Technicalities have been to a large extent avoided and the farmer will find in the science of manuring, as here presented to him, not so much a difficult subject of study as a help to the reasoned understanding of much that he knows from experience and a guide to the application of that knowledge on the soundest lines.

**SEED PRODUCTION AND MARKETING.** By Joseph F. Cox and George E. Starr. Pp. xviii + 450,  $8 \times 5\frac{1}{4}$ . (New York : John Wiley & Sons, Inc. ; London : Chapman & Hall, Ltd., 1927.) Price 20s.

In the preface to this volume it is stated that the publication of a book on the subject was considered to be fully justified in view of the fact that seed is of such



primary importance to agriculture and that its marketing and production involve so large a capital investment. The opening chapters are of a general nature and deal with the characters desired in seed for cultivation and for the market; the means of improving varieties by selection and hybridisation; the work of crop-improvement by associations and co-operative seed-distributing agencies; and the special cultural practices and equipment necessary for growing good seed. Consideration is then given to the production of special individual seeds or groups of seeds, and information is afforded regarding the different States in the United States where the various seeds discussed in the book are grown. In an appendix, methods are described for the treatment of the seeds to rid them of disease-bearing properties and for controlling the pests that attack the living plants. The book is well printed and is illustrated with about 200 figures. It should be of value to those for whom it is intended, namely, seed-growers, seedsmen and market gardeners, and also as a reference book in agricultural colleges.

**SEED TESTING.** By John Stewart Remington. Pp. xi + 144,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: Sir Isaac Pitman & Sons, Ltd., 1928.) Price 10s. 6d.

This well-illustrated work on seed testing is intended for the use of merchants, farmers and agricultural students. It gives an account of the methods of sampling, and of carrying out purity and germination tests, and the various forms of apparatus used for these purposes. The germination test being of primary importance, the author describes special methods of treatment which are required for particular seeds. An interesting table giving figures for the purity, germination and utility value of some eighty different kinds of agricultural seeds is provided, and a special chapter is devoted to flower seeds. A further chapter deals with the forms in which reports are made on samples submitted to a seed-testing station. Chapter IX, comprising almost half the book, is devoted to descriptions of the principal weed seeds found in samples of clover and grass seed, 392 different kinds being described.

**RECENT ADVANCES IN TROPICAL MEDICINE.** By Sir Leonard Rogers, C.I.E., M.D., B.S.(Lond.), F.R.C.P., F.R.C.S., F.R.S., Physician and Lecturer, London School of Tropical Medicine. Pp. viii + 398,  $8 \times 5$ . (London: J. & A. Churchill, 1928.) Price 12s. 6d.

In this volume the author has summarised in a very clear and informative manner the more noteworthy

recent advances in tropical medicine, giving special prominence to points likely to be of importance to isolated medical men in the tropics. The material has been largely taken from abstracts of literature published in the *Tropical Diseases Bulletin* and from the author's own articles in the *Medical Annual*, to which publications tropical practitioners often may not have access. Copious bibliographies are furnished throughout the work, which is excellently printed and arranged and should prove of much value as an authoritative compendium of the subject with which it deals.

COAL IN GREAT BRITAIN. By Walcot Gibson, D.Sc., F.R.S. Revised and Enlarged Edition. Pp. viii + 334, 8½ × 5½. (London : Edward Arnold & Co., 1927.) Price 21s.

The work under consideration is a second edition brought up-to-date. The first eight chapters of it are really a new issue of the author's *Geology of Coal and Coal Mining*, which was one of Arnold's well-known Geological Series. They occupy one-third of the book and may be looked upon as a general text-book on coal, dealing with its chemical and physical characters, its geological associations, its formation, origin and distribution, fossil indications, prospecting and boring, and exposed and concealed coalfields.

The rest of the book constitutes a specialised section, dealing entirely with the coalfields of Great Britain and Ireland. This part is also well illustrated with maps and diagrams showing the relations between the coal measures in different parts of the various coalfields.

The book is very clearly and interestingly written, and contains information not found elsewhere, so it can be confidently recommended.

ALUMINIUM BRONZE POWDER AND ALUMINIUM PAINT. By J. D. Edwards. Pp. 104, 9 × 6. (New York : Chemical Catalogue Company, Inc., 1927.) Price \$3.00.

The author of this book is a director of research with the Aluminium Company of America, so that it is authoritative. As its title suggests, it deals almost entirely with the manufacture, properties and uses of aluminium bronze powder, which, it may be explained to non-technical readers, is finely-stamped aluminium of at least 99 per cent. purity, the product being finally polished.

The method of manufacture of the powder is described, and short references are made to other forms of finely-

divided aluminium—atomised, grained and granulated—and their uses.

The physical characteristics of aluminium bronze powder are given and are illustrated by photo-micrographs. The properties and specifications for the ingredients of various aluminium paints, pyroxylin lacquers, bronzing liquids, bituminous paints and lacquers made with synthetic resins, in all of which aluminium bronze powder is used, are next given.

The high reflectivity of aluminium paint, among other uses, makes it suitable for keeping down the temperature of oil-storage tanks, whilst its low refractive properties make it valuable, when externally applied, for the heat insulation of certain furnaces. Other valuable properties, such as its perfect opacity, its resistance to moisture and to sulphur compounds, among a number of others, are described.

Aluminium bronze powder, apart from its use in paints, etc., has a number of other uses which are given in detail.

THE STRUCTURE OF THE ALPS. By Léon W. Collet, D.Sc. Pp. xii + 289,  $8\frac{3}{4} \times 5\frac{1}{2}$ . (London: Edward Arnold & Co., 1927.) Price 16s.

This book gives an account of the geology of the Alps from the tectonic (structural) point of view, and is sure of a welcome among English students of geology. The task of summarising the results of investigations in recent years on Alpine tectonics must have been a difficult one; but the author, who is well known for his investigations on this subject, has carried it out in very good style.

Part I is an introduction dealing with various general aspects of the subject, and includes a useful chapter of definitions. The author follows Suess, Termier and Argand, whose interpretations of Alpine tectonics are based primarily on the assumption that the Alpine area was formerly a geosynclinal region of sedimentation in a mediterranean sea to which Suess gave the name of *Tethys*. After the sediments had accumulated, the region was compressed between the African and European continental masses. The folding which ensued gave rise to two prominent geanticlines which developed into the two dominant "nappes" of the Alps, while the southern continental mass was thrust over the northern mass.

This gives the key to the author's regional tectonic division of the Alps. The Jura mountains, the Swiss plateau, the High Calcareous Alps and the crystalline Hercynian massifs constitute the "Foreland," dealt with in

part II of the book. Part III deals with "the Geosyncline or the Pennine Nappes"; part IV, "The Hinterland or Austrides"; and part V, "The Problem of the Prealps."

The subject is treated concisely and the book is excellently illustrated. It is provided with good bibliographies, and serves not only as a useful summary of modern views on Alpine tectonics, but also as a valuable guide to the extensive literature that has accumulated on this subject in recent years.

**GEOLOGISCHES PRAKTIKUM.** By Professor Dr. Rudolf Sokol. Pp. viii + 248,  $9\frac{1}{2} \times 6$ . (Berlin: Verlag von Gebrüder Borntraeger, 1927.) Price 14.50 Gold Marks.

This book of thirty-five chapters deals with the many aspects of practical geology, including the study of maps, the use of laboratory and field apparatus, field-mapping and fault-studies. A chapter on geophysical methods, including gravity, magnetic, electrical and other methods, gives the book an up-to-date appearance. There is a chapter on the cleaning and preparation of fossils, in which there is a good illustration of Sollas's serial-sectioning apparatus. The preparation of thin sections of rocks is explained in some detail, as also are various determinative methods available for the study and identification of rocks and minerals. Folding, faulting and other disturbances of strata are dealt with at considerable length. There is a chapter on building stones, and the book concludes with a brief bibliography, chiefly of German works.

**GUIDE PRATIQUE DE LA PROSPECTION DES MINES ET DE LEUR MISE EN VALEUR.** By Maurice Lecomte-Denis. Fourth edition. Pp. xx + 710,  $10 \times 6\frac{1}{2}$ . (Paris: Dunod, 1927). Price, bound Frs. 111, unbound Frs. 100.

This publication has been revised and brought up-to-date for this edition. It aims to serve as a general handbook for the assistance of the younger members of the mining engineering profession, containing most of the reference material required for the examination of virgin deposits or only partly developed mining properties.

The first quarter of the book contains information wanted prior to an investigation, followed by geology, palæontology, lithology, sampling, mapping, etc. The next third of the volume is devoted, in separate chapters, to petroleum, carbonaceous fuels, 17 common metals, slate and phosphates, each chapter being sub-divided, more or less, under headings such as ores, nature of deposits, analyses, valuation and economic data.

The rest of the book, which is of a general nature, deals with matters connected with the economics of mining, methods of preparing reports, the buying and selling of ores, financial organisation of mines, the flotation of companies, and the mining regulations of different countries. At the end of the book are a number of useful tables and a bibliography.

**HANDBOOK OF ORE DRESSING.** By Arthur F. Taggart. Pp. xvii + 1679,  $7\frac{1}{2} \times 4\frac{1}{2}$ . (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 50s.

It will be realised on the perusal of this almost monumental work to what dimensions the science of ore dressing has reached. The book would serve as an excellent companion volume to the well-known *Peele's Mining Engineer's Handbook*, containing everything an operator would want to know about the subject from the running of a crusher to the design of a complicated plant.

A general introduction is followed by a section on the dressing and treatment of coal and of a large number of metallic ores and non-metallic minerals, all illustrated with flow sheets from current practice. The selling of ores and mill products is treated next. Coarse, intermediate and fine crushing, with the crushing efficiencies of every type of reducing machinery, screening, hydraulic classification, washing, jigging, hydraulic concentration and flotation, are the subjects next dealt with. The remaining two-fifths of the book contains articles by specialists on transport, sampling, testing, design and construction of treatment plants, mathematics, physics, and theoretical and applied mechanics.

The volume concludes with tables of the elements and data on all the economic minerals, and an appendix. Throughout there is a wealth of information in the form of diagrams as well as a large amount of useful tabular matter. The book can safely be recommended as one of great use to the metallurgical engineer.

**THE METALLURGIST'S MANUAL.** By T. G. Bamford, M.Sc., and Harold Harris, M.Sc., F.C.S., with a foreword by Thomas Turner, M.Sc., A.R.S.M., F.I.C. (London: Chapman and Hall, Ltd., 1927.) Price 15s.

The first section of this work (58 pp.) is on sampling and assaying and includes the assaying of gold, silver and platinum, and the ores of the noble and base metals. Section two (41 pp.) deals with the analysis of various

alloys, and of cast iron and steels. Section three (29 pp.) is devoted to fuels and refractories. The fourth section (16 pp.) is on smelting, the fluxes and slags suitable for copper and lead smelting, copper smelting charge calculations, and iron blast furnace calculations. The fifth, sixth and seventh sections deal, respectively, with pyrometry, metallography and a summary of the manufacture of non-ferrous castings. The work concludes with a useful set of tables and index.

There are 55 figures in the text, including illustrations of pyrometers, indicating-instruments and recorders used in pyrometry, arrangements for photo-micrography, microscopes and photo-micrographs of various industrial alloys.

The book, although of moderate size, contains a large amount of technical information, carefully written and compiled, and should prove of great use to students as well as to those engaged in the actual practice of assaying, metallurgy and engineering.

**ELEMENTS OF OPTICAL MINERALOGY : An Introduction to Microscopic Petrography.** By N. H. Winchell and A. N. Winchell. Second edition, entirely re-written and much enlarged by A. N. Winchell. Part II, Descriptions of Minerals. Pp. xvi + 424,  $9\frac{1}{4} \times 6$ . (New York : John Wiley & Sons, Inc. ; London : Chapman & Hall, Ltd., 1927.) Price 27s. 6d.

The first part of this work dealing with Principles and Methods was noticed in this BULLETIN 1923, vol. 21, p. 420.

With the exception of a short introductory chapter on drawings, projections and diagrams, the present part is entirely devoted to descriptions of minerals, with special reference to their optical and microscopical characters. In such a work one might have expected that a classification based primarily on optical characters would have been adopted. In his preface, the author explains that he did make an attempt at such an arrangement, but that he was finally forced to reject it in favour of a scheme based on chemical and morphological affinities, a modification of Dana's familiar method.

The book is very comprehensive, including as it does all minerals the optical properties of which are sufficiently well established to permit of their identification by microscopic methods, and quite a number of opaque minerals are also included. Such a work must necessarily be very largely a compilation, and the literature has been very thoroughly searched for optical data, references to the source of information being given except where standard

reference works are concerned. In the course of this work of compilation, a considerable amount of new information has emerged as a result of the careful comparative study of existing data, and new theories regarding the chemical constitution of some of the isomorphous groups of silicates have been formulated. In particular the feldspars, on account of their great importance as rock-forming minerals and the large amount of optical data available regarding them, have been treated in considerable detail, 64 pages being devoted to this group.

The book is profusely illustrated with line drawings, graphs, diagrams showing variations of composition and optical properties within series, and photo-micrographs. The optical data have been very carefully compiled and presented, and the work is by far the most complete and handy reference book of its type yet produced.

SOIL MINERALOGY. By Frederick A Burt. Pp. vii + 82, 8 × 5½. (New York: D. Van Nostrand Company, Inc., 1927.) Price \$1.50.

This little book has been written as an aid to students and teachers of soil geology and mineralogy in the agricultural colleges of the United States. It is a brief and elementary text-book of mineralogy from which all minerals not found in soils, or used as mineral fertilisers, have been excluded.

In the first part, which deals briefly with general principles, the physical properties of minerals, the elements composing soil minerals, and the weathering of minerals, are discussed. The second part, which consists of four pages on the determination of minerals, contains determinative tables compiled almost entirely on a basis of lustre, specific gravity, hardness, cleavage, and chemical characteristics, without any regard to form or optical properties. Part 3 is devoted to descriptions of the minerals found in soils, descriptions which are in many cases very sketchy and quite insufficiently detailed to be of much use for distinguishing the various species. Part 4 consists of four tables; the first of these deals with the occurrences of minerals in the soils; the second deals with the relative resistance of minerals to weathering agencies; the third, taken from Van Hise, shows the volume changes involved in mineral alterations; the fourth is a list of the physical constants of the more important minerals, and includes specific gravity, molecular weight, molecular volume, specific heat and coefficient of cubical expansion, and seems out of place in a book of this nature.

Because the curriculum of an agricultural college in

the United States does not allow of a study of the elementary principles of crystallography, the author has omitted all reference to the investigation of soil minerals by means of the microscope. The omission of so profoundly important a method of investigation detracts considerably from the value of such a book as this.

## BOOKS RECEIVED FOR NOTICE

**BRITISH FARMERS IN DENMARK.** By J. R. Bond and other Members of the Mission of Inquiry into Denmark's Agricultural Methods. Reprinted from *The Daily Telegraph*. Pp. xi + 82,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London : Ernest Benn, Ltd., 1928.) Price 1s. 6d.

**YEAR BOOK OF AGRICULTURAL CO-OPERATION IN THE BRITISH EMPIRE, 1928** (with a World Survey of Co-operative Legislation). Edited by The Horace Plunkett Foundation. Pp. 456,  $8\frac{1}{2} \times 6$ . (London : George Routledge & Sons, Ltd., 1928.) Price 10s. 6d.

**INDIA OF TO-DAY. Vol. VIII. THE DEVELOPMENT OF INDIAN AGRICULTURE.** By Albert Howard, C.I.E., M.A., and Gabrielle L. C. Howard, M.A. Pp. 98,  $7\frac{1}{2} \times 4\frac{3}{4}$ . (London : Humphrey Milford, 1927.) Price 3s. 6d.

**COTTON IN SOUTH AND EAST AFRICA (BEING SOUTH AND EAST AFRICA COTTON YEAR-BOOK, 1926)** By W. C. Aman. Pp. xxiii + 156,  $7\frac{3}{4} \times 5\frac{1}{2}$ . (London : Longmans, Green & Co., Ltd. ; Johannesburg : R. L. Esson & Co., Ltd., 1927.) Price 6s.

**OILS, FATS AND FATTY FOODS : THEIR PRACTICAL EXAMINATION.** By E. Richards Bolton, F.I.C., F.C.S., with a chapter on Vitamins by J. C. Drummond, D.Sc., F.I.C. Being a Second Edition of "Fatty Foods," by E. Richards Bolton and Cecil Revis. Pp. xvi + 416,  $9\frac{3}{4} \times 5\frac{3}{4}$ . (London : J. & A. Churchill, 1928.) Price 30s.

**SUGAR BEET AND BEET SUGAR.** By R. N. Dowling. With a Foreword by Sir Daniel Hall, K.C.B., F.R.S., LL.D., D.Sc. Pp. x + 277,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London : Ernest Benn, Ltd., 1928.) Price 15s.

**TRUCK CROP PLANTS.** By Henry Albert Jones, Ph.D., and Joseph Tooker Rosa, Ph.D. Pp. xiv + 538,  $9 \times 6$ . (London : McGraw-Hill Publishing Co., Ltd., 1928.) Price 25s.



THE INDIAN MATERIA MEDICA. Edited and Published by K. M. Nadkarni. Pp. 1450,  $7\frac{1}{2} \times 4\frac{1}{2}$ . (Bombay: The Author, 1927.) Price 18s.

ELECTRO-FARMING, OR THE APPLICATION OF ELECTRICITY TO AGRICULTURE. By R. Borlase Matthei, Wh. Ex., A.M.Inst.C.E., M.I.E.E., F.R.Ae.S. Pp. xvi + 357,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: Ernest Benn, Ltd., 1928.) Price 25s.

THE MANUFACTURE OF ARTIFICIAL SILK WITH SPECIAL REFERENCE TO THE VISCOSE PROCESS. By E. WHEELER, M.B.E., A.C.G.I., A.I.C. Pp. xv + 150,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: Chapman & Hall, Ltd., 1928.) Price 12s. 6d.

THE CORNISH MINER. By A. K. Hamilton Jenkin, M.A., B.Litt.(Oxon.). Pp. 351,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: George Allen & Unwin, Ltd., 1927.) Price 12s. 6d.

THE ELEMENTS OF ECONOMIC GEOLOGY. By J. W. Gregory, D.Sc., F.R.S., M.I.M.M. Pp. xv + 312,  $7\frac{1}{2} \times 5$ . (London: Methuen & Co., Ltd., 1928.) Price 10s.

MINING ENGINEERS' HANDBOOK. Editor-in-Chief, Robert Peele. Second Edition. Pp. xiv + 2523,  $7 \times 4\frac{1}{2}$ . (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 50s.

MODERN COAL-WASHING PRACTICE. By R. C. R. Minikin. Pp. 310,  $9\frac{3}{4} \times 7\frac{1}{4}$ . (London: Ernest Benn, Ltd., 1928.) Price 45s.

TECHNICAL METHODS OF ORE ANALYSIS FOR CHEMISTS AND COLLEGES. By Albert H. Low, Sc.D. Tenth Edition, Revised. Pp. xxxiv + 348,  $9 \times 5\frac{3}{4}$ . (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 17s. 6d.

HANDBOOK OF CHEMISTRY AND PHYSICS. A READY-REFERENCE POCKET BOOK OF CHEMICAL AND PHYSICAL DATA. By Charles D. Hodgman, M.S., and Norbert A. Lange, Ph.D. Twelfth Edition. Pp. xi + 1112,  $6\frac{1}{2} \times 4\frac{1}{2}$ . (Cleveland, Ohio: Chemical Rubber Publishing Co., 1927.) Price \$5.00.

A MANUAL OF FIELD ASTRONOMY. By Andrew H. Holt. Second Edition. Pp. xiv + 126,  $6\frac{1}{2} \times 4$ . (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 10s.

THE HUMAN HABITAT. By Ellsworth Huntington. "Pp. xii + 293,  $8\frac{1}{2} \times 5\frac{3}{4}$ . (London: Chapman & Hall, Ltd., 1928.) Price 15s.

## REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

*Selected from the reports made to the Dominion, Colonial  
and Indian Governments*

### TOBACCO INDUSTRY OF MAURITIUS

THE efforts now being made in Mauritius to produce a tobacco suitable for export to this country give every promise of success. It was pointed out in an earlier article in this BULLETIN (1926, 24, 200) that the tobacco then being grown on a small scale in the island was only used for making "tabac bleu" for the local market and was quite unsuitable for export. At the suggestion of the Imperial Institute cigar filler tobacco was grown experimentally, but samples which were sent for examination showed that the results were not satisfactory (*loc. cit.*), and efforts have since been concentrated on producing pipe and cigarette tobaccos.

According to information supplied to the Imperial Institute in August 1927 by Dr. H. Tempany, the Director of Agriculture, it was estimated that there were at that time 2,000 acres under tobacco in Mauritius, whilst thirty-one flue-curing barns had been erected and were working. Six tobacco factories were operating in Port Louis, one owned by the British American Tobacco Company, and five by Chinese manufacturers. The British American Tobacco Company's factory is small but up-to-date and is manufacturing cigarettes from imported leaf, from blends of local and imported leaf, and also a 100 per cent. Mauritius tobacco cigarette. The Chinese factories are less well equipped, but some of them include modern cigarette machinery and it is understood that further improvements in the machinery are contemplated; in

addition to cigarettes made of bright tobacco they are manufacturing a large amount of black tobacco of the type formerly imported into the island from Bourbon. The importations from Bourbon, which formerly amounted to 150,000 and 200,000 kilos., have practically ceased. The Government Tobacco Factory, which had been in existence for eight years, and from whose operations these developments have very largely arisen, has now been closed, as it was considered that with the existence of the facilities mentioned above it was no longer required.

In view of the development of the tobacco industry, the Director of Agriculture pointed out the great importance of controlling the export from the beginning, and at his suggestion the Governor, in January 1927, appointed a Committee to consider measures for organising the export of tobacco on a commercial scale.

The Committee reported that although ultimately the control of the leaf for export would probably be capable of accomplishment by means of a co-operative organisation of growers to which the services of the Government Grading Expert could be adjoined, they considered that, in the first instance, as the export of tobacco was in its infancy, it would be better if the grading operations were left under Government control through the medium of the Department of Agriculture. They pointed out that such control would be possible under the existing Customs Law and advised that the export of tobacco should be prohibited unless accompanied by a grading certificate issued by the Director of Agriculture.

The Committee further considered that assistance in the way of advances might be given to the smaller planters who desired to have their produce exported by the Government.

The Committee also suggested that a small Advisory Committee should be appointed to assist in connection with the working of the grading factory, and considered that such a Committee would probably pave the way for a co-operative concern at a later date.

The recommendations of the Committee were adopted, and in May 1927 a proclamation was issued prohibiting the exportation of tobacco grown in Mauritius except

upon a certificate signed by the Director of Agriculture that the tobacco has been graded; the sum of Rs. 60,000 has been voted by the Council of Government as an advance to tobacco growers on shipments.

A Government Tobacco Warehouse has been established at Port Louis for the grading, conditioning, packing and export of tobacco leaf, and a certificate is only issued in respect to tobacco which has been graded and packed at this warehouse.

Since the introduction of this scheme the quality of tobacco exported from Mauritius has greatly improved and there is every indication of a market for the tobaccos in the United Kingdom.

Five samples of "Yellow Prior" tobacco which had been graded and packed under the above scheme were received at the Imperial Institute in December 1927. They were stated to represent the 1927 crop of Virginian tobacco.

The characters of the samples, which each consisted of two hands, are summarised in the following table:

Label.	Weight.	Size of Leaf.	Colour of Leaf.	Texture of Leaf.
	os.	inches.		
Var. Yellow Prior :	10	17 × 9 to 23 × 12½	Light orange (a few yellowish); dull. Not light enough to be termed "bright."	In good condition. Fair substance; butts well feathered; midribs fair; veins white.
A. Grade BA. (Brights 2nd grade)				
B. Grade BU. (Brights 3rd grade)	10	16 × 8½ to 23 × 11½	Darker than A; somewhat mottled; dull.	Do. do.
C. Grade MR. (Medium 1st grade)	10	19 × 8 to 24 × 14	Dark mottled orange; dull.	In good condition. Rather heavier than A or B; butts well feathered; midribs fair; veins white.
D. Grade BP. (Brights perished and damaged)	9	17 × 8½ to 21 × 12	Similar to A.	Similar to A. Some leaves slightly spotted and broken; some rather harsh.
E. Grade MP. (Medium perished and damaged)	10½	16 × 6½ to 22 × 10½	Mixed. Some similar to B; others to C.	Similar to A. Some slightly spotted and torn; some rather harsh.

All the samples, on arrival at the Imperial Institute, were in a suitable condition for the market as regards the amount of moisture present.

The leaf in each case when cut was observed to have a slight odour of mineral oil, apparently due to contamination either during storage or while in transit.

Samples A and C were selected for analysis and gave the following results which, for convenience of comparison, are expressed on a basis of 14 per cent. of moisture :

	Sample A. (Grade BA.) <i>Per cent.</i>	Sample C. (Grade MR.) <i>Per cent.</i>
Moisture . . . . .	14.0	14.0
Nicotine . . . . .	3.88	5.41
Nitrogen . . . . .	2.02	2.53
Ash . . . . .	10.3	11.1

The ash was analysed with the following results :

—	Sample A (Grade BA.)		Sample C (Grade MR.)	
	Ash as prepared.	Calculated on CO <sub>2</sub> -free ash	Ash as prepared	Calculated on CO <sub>2</sub> -free ash.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Lime. . . . . CaO	34.75	43.83	33.12	43.36
Magnesia . . . . . MgO	11.31	14.27	9.93	13.00
Potash . . . . . K <sub>2</sub> O	17.74	22.39	17.42	22.80
Soda . . . . . Na <sub>2</sub> O	1.55	1.96	1.18	1.55
Sulphates, expressed as sulphuric anhydride. SO <sub>3</sub>	5.78	7.29	7.16	9.37
Chlorides, expressed as chlorine . . . . . Cl	3.99	5.03	3.67	4.81
Carbonates, expressed as carbon dioxide . . . CO <sub>2</sub>	20.72	—	23.62	—

The samples were found to have good burning properties, although the combustion was not quite so free as is desirable. The flavour in all cases was rather full, slightly coarse and pungent, and possessed a slight "twang."

The results of the chemical examination show that Grade BA contains a rather high percentage of nicotine, and Grade MR still more, tending to produce coarseness in flavour. The composition of the ash is very similar in both cases (the chief difference being in respect of the amount of sulphates), and is fairly satisfactory, though the percentages of sulphates and chlorides are rather higher than desirable. These two constituents adversely in-

fluence the burning properties of tobacco and together should not exceed 8 per cent. of the CO<sub>2</sub>-free ash. The amount of potash present is, however, fairly high and, judging by the burning qualities of the leaf, appears sufficient to counteract to a large extent the effect of the sulphates and chlorides.

The samples were submitted to merchants and manufacturers, whose reports may be summarised as follows:

(1) The merchants expressed considerable interest in the tobaccos, and were of opinion that if similar leaf could be produced in bulk for export it should be possible to find a market for it in the United Kingdom. The grading was stated to be very satisfactory and quite suitable for bulk shipments. The firm regarded the tobacco as of a good Virginian type, and although it does not possess the very bright colour of the leaf produced in Southern Rhodesia, it has the advantage of being tougher and consequently less likely to break and fall to pieces in the process of manufacture. They considered the colour of the leaf to be "Medium Bright," i.e. between "Bright" and "Semi-bright."

(2) The manufacturers described the samples as apparently ripe and well cured, of medium or short length, and with more "body" than is usual in most other kinds of bright leaf from Empire sources. They stated that the leaf cut well, showing only a small proportion of "smalls," and that its burning qualities were good, the smoke being free from harshness and fairly cool. The flavour was peculiar and "sweetish," but not so pronounced as to preclude the blending of the leaf with other tobaccos; it was, however, rather strong, especially in the case of the medium grade (Samples C and E), and the leaf would therefore be more suitable for pipe-smoking than for cigarettes. The grading was considered to be quite satisfactory, and the firm stated that if it is intended to continue the cultivation of such leaf in Mauritius for export they would be glad to receive a few trial bales in order to carry out proper manufacturing tests and assign a definite value to the tobacco.

Attention was drawn by the manufacturers to the fact that all five samples were tainted with the smell of oil.

From the foregoing results it will be seen that although the present tobaccos are not quite equal in burning properties and flavour to the same type of leaf as grown in Nyasaland and Rhodesia, they are of very promising quality and possess the advantage of having good substance. Such leaf would be suitable for use in pipe tobaccos, and might possibly be employed in blends for cigarette-making, especially if improved in quality.

The reports of the commercial experts indicate that there would be a market for the tobaccos in the United Kingdom, and the Imperial Institute has suggested that a few bales should be sent for transmission to the manufacturers for trial.

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### WOOL AND MOHAIR FROM IRAQ

IN connection with the attempts being made by the Ministry of Agriculture, Iraq, to improve the breeds of local sheep and goats as sources of wool and mohair (see p. 215), two sheep fleeces and five Angora goat fleeces were sent for examination to the Imperial Institute by the Inspector-General of Agriculture in October 1927. The results of their examination are given below.

#### SHEEP FLEECES

The fleeces were stated to represent a mountain type of sheep, bred in Rowanduz and known as the Qara Goz breed, Adami variety. The sheep had been brought down to the Government Farm near Baghdad in January 1927 and appeared to have thriven well in spite of the change of climate. The fleeces were as follows.

S 1.—Weight 2½ lb. This fleece, which was largely in the form of matted lumps, consisted of fairly lustrous, rather coarse wool, pale cream to pale brown in colour. A few pieces of dark brown wool were present. The wool was in fairly clean condition, but was stained yellow in places.

S 2.—Weight 1 lb. 7 oz. This sample was composed of pale cream to pale brown wool, fairly lustrous and rather softer than that of sample S 1. The wool was in a fairly clean state, but stained yellow in parts.

The fleeces were brought to the notice of the Imperial Institute Advisory Committee on Animal Fibres, and the Chairman, Mr. F. A. Aykroyd, kindly undertook to examine them in detail. Mr. Aykroyd analysed the wools and prepared a set of mounted reference specimens showing the wide variation in the staple, for the information of the Iraq authorities. He also furnished the following observations.

*Sample S 1.*—This fleece contains quite a quantity of valuable hosiery wool after the strong hairs have been removed, which leads one to suppose that a useful wool could be bred from these sheep, but it would take time to breed out the thicker hairs. The latter are very shiny, which again is nearer a hair than wool in breed, but they are moderately free from the dead hair or kemps.

*Sample S 2.*—This fleece is much worse and lower in character than S 1, but the same remarks apply. It would be quite possible to breed a useful hosiery wool from either of the present fleeces.

Mr. Aykroyd added that "the result of the cross, as exists now, shows what happens when the crossing of sheep is not controlled and they are allowed to roam and do as they will. Thirty years ago much of the Chili wool was far worse than this, and some parts of the South American were worse. They have now been improved out of all recognition."

#### ANGORA GOAT FLEECES

These fleeces were stated to represent Angora goats bred at Rowanduz. The goats had been brought down to the Government Farm near Baghdad in January 1927, and appeared to have thriven well in spite of the change of climate. The fleeces were as follows:

*A 1.*—Weight, 2 lb. 13 oz. Pale cream to pale brown hair, fairly clean on the whole but in parts rather dirty. The sample was rather lumpy and taily.

*A 2.*—Weight, 2 lb. 7 oz. Generally similar to sample A 1 though the hair appeared somewhat harsher.

*A 3.*—Weight, 1 lb. 13 oz. Rather dark reddish-brown to greyish-brown hair, in fairly clean condition but matted, lumpy and taily.



*A 4*.—Weight, 17 oz. Hair somewhat resembling sample *A 3*, but rather softer and paler.

*A 5*.—Weight, 3 lb. 14 oz. Matted lumps, mostly of black hair, but containing a small proportion of white hair. The hair was fairly uniform in appearance and in moderately clean condition.

The fleeces were brought to the notice of the Imperial Institute Advisory Committee on Animal Fibres, and a member of the Committee, Mr. J. M. McLaren, of Messrs. Jeremiah Ambler and Son, Ltd., of Bradford, kindly undertook to examine them in detail. Mr. McLaren furnished the following report and recommendations :

*White Samples A 1 and A 2*

The hair in these samples shows a decided lack of lustre and quality, and instead of being bright has more the appearance of wool. The colour is not good and the amount of kemp is excessive. Black hairs run throughout the staples ; this reduces the market value to a very great extent. The black hairs are probably due to cross breeding with coloured goats and are more usual in goats of an inferior breed. Rams showing kemp and black hair should not be used for breeding purposes. In South Africa great care is taken with stud rams and those showing these faults are not considered at all desirable. Great care must be exercised in getting the right stamp of ram from which to breed, and this should be chosen by an expert breeder.

The fleeces will not command a good market price until the black hair is eliminated. As the lustre and quality are not good, the fleeces are below the standard of average Turkey and would be valued at 30 to 40 per cent. less.

Another point noticeable in these fleeces is a decided lack of natural grease as though the goats have been wrongly nourished or wrongly kept.

*Brown Samples (A 3 and A 4) and Black Sample (A 5)*

The brown samples (Nos. 3 and 4) are "gingerlines" of an inferior quality ; they are lacking in lustre and have too much the appearance of wool. As in the white samples the lack of natural oil makes them harsh. The coloured

hair is not as valuable as the white, which should be grown instead of coloured hair wherever possible.

Where coloured hair and white hair are grown together there is always a risk of inter-breeding, and the cross-bred animal is very undesirable. The white fleeces and coloured fleeces should be kept apart as if they are packed or even clipped together the white fleeces pick up dark hairs which cause a lot of trouble.

Mr. McLaren also furnished the following general observations on the fleeces :

The samples as a whole show some points in common ; firstly, the lack of lustre ; secondly, the lack of quality ; thirdly, harshness. The lustre is most important, and everything should be done to preserve and improve the brightness of the hair as brightness is one of the chief assets of mohair. The quality should also be improved, as the market price depends largely on the quality of the hair, provided it is of sufficient length. In the case of these samples the length is all right.

The harshness is very pronounced and the fleeces have the appearance of having been clipped from goats which are not in good health. The time the fleece is allowed to grow should also receive attention ; in Turkey and some parts of South Africa the goats are clipped once a year, but as a general rule in South Africa they are clipped twice a year.

The lack of natural grease shows that the goats are not getting the right food or are not kept under suitable conditions.

The mohair fleeces most in demand are those of the style produced in the Beybazar and Angora districts.

In illustration of his remarks on the white samples (A 1 and A 2), Mr. McLaren supplied mounted specimens of this mohair and of Turkey mohair for comparison.

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## THE TOXIC PROPERTIES OF WEST AFRICAN RATSBANE

IN January 1927 a sample of the nuts (fruits) of the so-called ratsbane of West Africa (*Chailletia toxicaria* G. Don) was received from the Commissioner of Lands and Forests,

Sierra Leone, with a request that the physiological properties of the poison contained in the seeds might be determined and the possible use of the nuts as a rat poison investigated.

The nuts of *C. toxicaria*, known in Sierra Leone under the Mendi name of Magbevi, are employed in that country for destroying rats and other animals and are said to have been frequently used by the Timnes and Mendis to poison well-water or streams which supply hostile villages.

As enquiries showed that these nuts had not been previously tried as a rat poison in this country, Prof. B. A. McSwiney of the School of Medicine, University of Leeds, kindly undertook to have such trials carried out. The experiments were conducted by Dr. M. Rabinovich whose report is printed below.

#### INVESTIGATION ON THE TOXICITY OF THE MAGBEVI NUT IN RATS

By Dr. M. Rabinovich.

The object of this investigation has been to determine the toxicity of the Magbevi Nut (*Chailletia toxicaria*) to rats. The nut is used largely as a rat poison in the Colony of Sierra Leone and is known to have toxic effects on man (1). Power and Tutin (2) carried out chemical investigations on the fruit. These observers were unable either to separate the active principle or to find any evidence of the presence of an alkaloid, cyanogenetic glucoside or soluble protein to which its highly poisonous properties could be attributed. They concluded that it contained at least two active principles, one of which causes cerebral depression or narcosis and the other cerebral excitation, leading to epileptiform convulsions. The portion which causes convulsions is very slowly excreted, so that a cumulative effect is produced by the administration of a series of individually innocuous doses.

The experiments were performed on 38 tame white rats whose weight varied from 55 to 210 grms. Preliminary experiments showed that the shell had a very low degree of toxicity and it was therefore decided to use the kernel. It was found that the rats did not eat the ground-

up kernel readily, and so a small quantity of pea meal was added and reduced to a pasty consistency by the addition of a few drops of a solution of glucose. This mixture was eaten very readily by the animals. Its palatability was tested by offering the rats a toxic and non-toxic paste simultaneously. The former was, if anything, preferred.

The animals were starved for forty-eight hours and were then placed in separate metal cages, a definite amount of the kernel being given as described. A plentiful supply of water was provided throughout the experiment.

Fairly large doses, e.g. 0.1 to 0.5 gm. of powdered kernel were used in preliminary experiments, but the dose was gradually decreased until an approximate estimation of the minimum lethal dose was obtained; it was found to be less than 0.05 gm. Twenty-four experiments were then performed with approximately the minimum lethal dose. The rats which did not succumb to this amount of poison were given additional small quantities every day until the cumulative effect was fatal. Lastly a few animals were given small daily doses of 5 to 10 mgms. until the cumulative effect caused death.

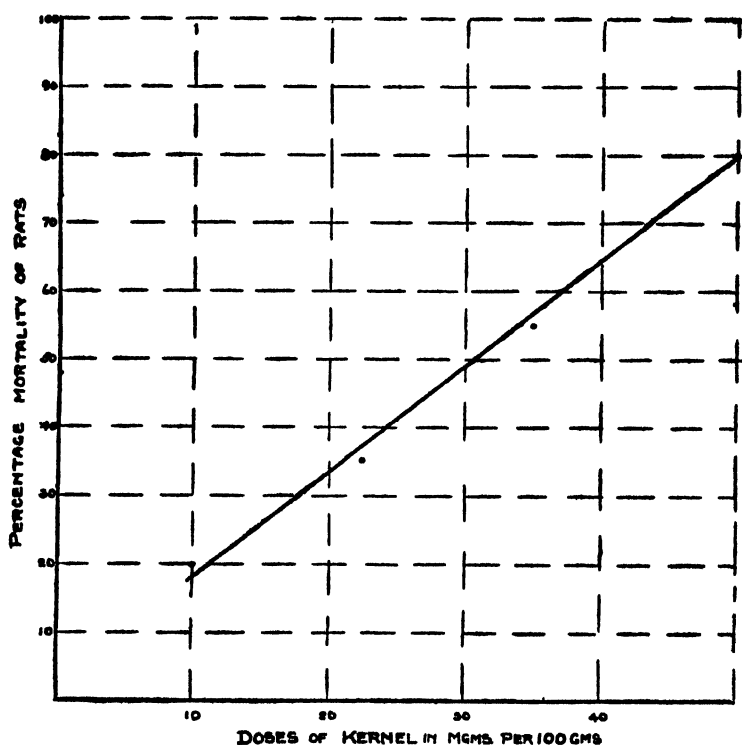
By this procedure the minimum lethal dose was found to be 36 mgms. per 100 gms. rat. The maximum dose that failed to kill was found to be 62 mgms. per 100 gms. rat and the smallest quantity that proved fatal was 5 mgms. per 100 gms. Control animals kept under similar conditions survived.

The effect of the poison was found to be cumulative, and this result is illustrated by a few examples given in Table I. These and similar experiments showed that the minimum fatal dose found by daily addition is practically the same as if given in one single dose. The great variation in susceptibility is also illustrated, for while on the whole the heavier rats required a bigger dose to kill, there are many instances of large rats being killed with relatively small amounts of the poison. The biggest rat used weighed 210 grms. and was killed by a single dose of 10 mgms., whereas the smallest rat, which weighed 55 grms., required three consecutive daily doses of 10 mgms. before a fatal result could be obtained.

Table I

Rat No.	Weight of Rat.	Doses on consecutive days in mgms.					Fatal Dose.	Fatal Dose per 100 gms.
		Days.						
	gms.	1st.	2nd.	3rd.	4th.	5th	mgms.	mgms.
1	100	25	5	5	5	5	45	45
2	110	25	—	—	—	—	25	23
3	100	25	5	5	5	—	40	40
4	75	25	5	5	5	5	45	56
5	90	25	5	—	—	—	30	33

Owing to the cumulative effect of the poison the additive methods give a very good idea of the minimum lethal dose of individual animals. The average lethal dose as employed by Trevan (3) was also determined from the results obtained. It is the weight of the drug per kilogram of animals which, when administered to an indefinitely large number of animals, will kill just half their number. A mortality curve was plotted and is reproduced below,



and from it, it is found that the average lethal dose is 300 mgms. or 30 mgms. per 100 gms. rat.

To investigate whether the animals would die in the open or not, a long wooden box with the food inside was attached to the cage. The results obtained were, however, so variable that no conclusions could be drawn from them.

The toxic principles or constituents of the nut kernel appear to be thermo-stable as the toxicity of the powder does not appear to be reduced by autoclaving.

The symptoms produced by the poison are very definite. Within 2 to 5 hours of ingestion, the animal suddenly suffers from epileptiform convulsions with marked dyspnoea and cyanosis. This condition usually lasts for some 5 to 15 seconds and leaves the animal paralysed in the hind limbs. Occasionally the paralysis is more generalised, and if the dose is fatal, death follows within 12 hours. Partial recovery may be followed by one or more seizures before death ultimately takes place. With sub-lethal doses no symptoms may be observed, but, if convulsions are produced, recovery may result even after one or more attacks.

Characteristic changes were found on post-mortem examination. The heart was observed to be dilated and markedly congested, especially on the venous side; congestion of the brain was also noticed, but the thrombosis of the superior longitudinal sinus as described by Power and Tutin (2) was not present in any animal examined. In five animals morbid changes were found in the lungs, viz. congestion (2 cases), local consolidation (2 cases) and abscess formation (1 case). Congestion of the liver and of the testes was occasionally observed.

The conclusion is drawn that the kernel of *Chailletia toxicaria* is toxic to white tame rats in doses varying from 9 to 12 mgms. per 100 gms., the average lethal dose being less than 36 mgms. per 100 gms. rat. Characteristic symptoms are produced and definite morbid changes are found on post-mortem examination.

Experiments with wild rats are now in progress, and an opportunity is being sought for testing the material in a rat-infested building.

#### REFERENCES

- (1) Renner. *British Med. Journ.*, 1904, p. 1314.
- (2) Power and Tutin. *J. Amer. Chem. Soc.*, 1906, xxviii, 1190.
- (3) Trevan and Boock. *Document C.H.* 398 (8) of the Health Organisation of the League of Nations.

## FULLER'S EARTH FROM NEW ZEALAND

THE sample of fuller's earth which is the subject of this report was forwarded to the Imperial Institute by the High Commissioner for New Zealand in May 1927, in order that it might be submitted to technical trials and a report furnished on its commercial value.

The material was stated to have been obtained from a deposit varying from 10 to 40 ft. in thickness, and situated a few chains from the Ruatangata railway station, approximately 4 miles from Whangarei in the North Auckland district.

## RESULTS OF EXAMINATION

The sample received for examination consisted of about  $\frac{3}{4}$  lb. of a brownish-white, powdery fuller's earth.

As the most important use for high-grade fuller's earth is that of "bleaching" vegetable oils, a series of tests were carried out at the Imperial Institute in order to determine how the New Zealand mineral compared with good quality English fuller's earths used for this purpose. Trials were therefore made using "neutralised" cotton-seed oil and raw soya-bean oil and comparing the bleaching action of the New Zealand fuller's earth on these oils with that of good-quality Surrey and Somerset fuller's earths. The amount of bleaching which the oil had undergone in each case was measured by means of the Lovibond tintometer.

The New Zealand earth was prepared for the tests by grinding it so that all passed a 100-mesh sieve, and then drying at a temperature of 80° to 90° C. This treatment resulted in a loss of 10.61 per cent. of moisture. It may be mentioned that this grinding and drying is the treatment usually given to fuller's earth quarried in the United Kingdom.

For purposes of comparison the additional moisture lost by treating at 105° C. was determined on this mineral, and also on the three English reference samples, with the following results :

				Additional loss at 105° C. <i>Per cent.</i>	
	Whangarei Fuller's Earth, 100-mesh	.	.	.	1.34
	Surrey " " 80- "	.	.	.	2.76
"	Somerset " " 140- "	.	.	.	2.90
	Somerset " " 90- "	.	.	.	1.76

Comparative bleaching tests were made on the cotton-seed and soya-bean oils with the three reference samples, and the prepared Whangarei earth, under standard conditions, with the following results :

*Bleaching of Cotton-Seed Oil*

—	Colour as measured by the Lovibond Tintometer.		Bleaching action as measured by reduction in colour.	
	Yellow.	Red.	Yellow.	Red.
Oil <i>before</i> treatment with earth .	11.0	1.5	—	—
Oil <i>after</i> treatment with :				
(a) Whangarei earth . . .	1.5	0.5	9.5	1.0
(b) Surrey 80-mesh . . .	4.0	1.0	7.0	0.5
(c) Somerset 140-mesh . . .	4.0	1.0	7.0	0.5
(d) Somerset 90-mesh . . .	4.0	1.0	7.0	0.5

*Bleaching of Soya-Bean Oil*

—	Colour as measured by the Lovibond Tintometer.		Bleaching action as measured by reduction in colour.	
	Yellow.	Red.	Yellow.	Red.
Oil <i>before</i> treatment with earth .	37	2	—	—
Oil <i>after</i> treatment with :				
(a) Whangarei earth . . .	35	2	2	0
(b) Surrey 80-mesh . . .	35	1.8	2	0.2
(c) Somerset 140-mesh . . .	36	1.7	1	0.3
(d) Somerset 90-mesh . . .	36	1.5	1	0.5

The above results show that in regard to its bleaching action on cotton-seed oil the Whangarei is rather superior to certain varieties of good-quality English fuller's earth ; but, like the English earth under the conditions of test, its action had very little effect on soya-bean oil. It may be mentioned that a reduction of the colour of an oil to one-third of its original intensity is considered to be satisfactory for a good fuller's earth. It will be noted that in the case of cotton-seed oil the reduction effected by the Whangarei earth exceeds this amount.

It has been observed recently that the bleaching effect



on vegetable oils of some types of fuller's earth is increased if the latter be ignited before use.

Experiments were therefore made in order to ascertain if the soya-bean oil could be more effectively bleached by ignited fuller's earth. The ground earths were ignited for four hours at 600° C. and bleaching tests carried out as before, but while no improvement resulted with the ignited Surrey and Somerset earths, there was, however, a marked increase in the bleaching action in the case of the ignited Whangarei earth. The results obtained were as follows :

*Bleaching of Soya-Bean Oil*

	Colour as measured by the Lovibond Tintometer.		Bleaching action as measured by reduction in colour.	
	Yellow.	Red.	Yellow.	Red.
Oil <i>before</i> treatment with ignited Fuller's earth . . . .	37	2.0	—	—
Oil <i>after</i> treatment with ignited earth from :				
Whangarei . . . . .	10.5	1.2	26.5	0.8
Surrey . . . . .	35	1.2	2.0	0.8
Somerset . . . . .	36	1.5	1.0	0.5
Somerset . . . . .	36	1.5	1.0	0.5

In the case of the cotton-seed oil no increased bleach was obtained when using the ignited earths. The small quantity of the Whangarei earth available prevented experiments being carried out on the effect of igniting the earth at temperatures other than 600° C.

The bleaching effect produced by both the raw and ignited Whangarei earth was permanent up to the time of making this report (8 weeks after bleaching). No difficulty was experienced in the filtration of oil bleached with the earth.

A small sample of the Whangarei earth was submitted to a firm using large quantities of fuller's earth for bleaching vegetable oils for margarine manufacture. They confirmed the opinion arrived at here and stated that they considered the earth to be equal to good quality English fuller's earth. They considered the dried and ground Whangarei earth

would be worth about £4 5s. per ton delivered in the United Kingdom.

It appears somewhat unlikely that it would be possible to market remuneratively the Whangarei earth in the United Kingdom, both on account of price and the fact that a fair proportion of the quantity produced here has to be exported.

### SUMMARY AND CONCLUSIONS

Technical trials at the Imperial Institute and the opinion of a large user of fuller's earth show that the Whangarei fuller's earth, when suitably dried and ground, is equal to good-quality English fuller's earth, which at the present time sells at about £4 5s. per ton in the United Kingdom.

## ARTICLE

### THE LIGNITES AND BROWN COALS OF THE BRITISH EMPIRE, AND THE USES TO WHICH THEY MAY BE PUT

BY SIR RICHARD REDMAYNE, K.C.B.

LIGNITE or Brown Coal is immature coal, chemically and physically something between peat and true bituminous or black coal, but just as true bituminous coal varies in quality, so does lignite. The term "brown coal" is applied to those lignites which are brown in colour and earthy in texture. The term "lignite" is more properly applicable to wood-like coal, though it has become a generic designation for all the immature coals. Some lignites are black and glossy, as, for instance, that at Waikato, New Zealand; and brown coals sometimes grade into the black variety, which approximates closely to true bituminous coal. The term "sub-bituminous coal" is used by the Geological Survey of the United States to cover what has generally been called "black lignite"; for, seeing that all such coal is not lignitic in the sense of being woody, the latter term is objectionable. Though lignites and brown coals vary greatly in chemical composition as well as in appearance, they have two outstanding

characteristics in common, namely, a high moisture and a high volatile hydro-carbon content and, in consequence of the former characteristic, a low calorific value.

The moisture content is sometimes as high even as 60 per cent.—the average being between 14 and 15 per cent. The volatile hydro-carbon content varies from about 27 to 53 per cent. with an average of 40 to 41 per cent. The fixed carbon content varies between 16 and 51 per cent. with an average of 36 per cent. The ash content is very variable, namely, from about  $2\frac{1}{2}$  per cent. to as high as 42 per cent.

In view of the poor quality of these coals as compared with true bituminous or black coal, the question naturally arises for answer—how can it pay to work them in competition with the latter in a country possessed of both classes of coal? The answer is it would not pay to do so unless the lignite or brown coal could be raised at a much lower price than the more valuable bituminous coal. One may quote in this respect the case of the brown coal of Germany, where during 1926 over 139 million tons were raised against 143 million tons of black or true coal—and the brown coal of Germany is not a coal of high class, for the moisture content ranges between 40 and 60 per cent., the ash content from 5 to 20 per cent., the volatile hydro-carbon content from 20 to 30 per cent., and the calorific value from 3,270 to 5,760 B.Th.U. It is usually reckoned that 1 ton of German true coal is equivalent in heat value to 2.8 tons of German brown coal. These particulars in regard to German brown coal are mentioned in order to emphasise the fact that it pays to work the inferior article on an enormous scale because it is "got" at such a low working cost—either from the open-cast workings or by true mining—a cost much below that at which the true coal can be raised.

Usually the deposits of brown coal are much thicker than those of true coal, and occur at shallow depths from the surface.

Of the 7,397,553 million metric tons of coal of all sorts in the world no less than 2,997,763 million, or over one-third, are lignite and brown coal. Although the resources of lignite and brown coal in Great Britain are of

negligible quantity, the Empire itself contains vast supplies of them. Thus, in the Latrobe Valley alone, in Australia, there are over 31,144 million tons of brown coal. New Zealand contains, it has been estimated, 513 million tons of lignite and brown coal. In Alberta, Canada, the estimated reserves amount to 382 million tons, besides which there are extensive deposits in Saskatchewan and British Columbia, and these coals occur in the foothills throughout almost the whole of the extra-peninsular India, from Baluchistan on the north-west to Assam on the north-east. There are also extensive and valuable deposits in Nigeria.

The quality of sub-bituminous and brown coal varies, and consequently the value. Thus, to take a notable case, that of the Waikato lignite slack coal in New Zealand, the analysis showed it to be quite a good coal, for though the moisture content was high (though not so for a lignite), that of ash was very low. It contains :

Moisture . . .	15.00 per cent.
Volatile hydro-carbons	38.84 ..
Fixed carbon .	41.75 ..
Ash . . .	4.41 ..
Sulphur . . .	0.76 ..
Calorific value .	10,206 B.Th.U.

A typical brown coal as worked in mid-Germany gave the following analysis :

Moisture	49.5 per cent.
Carbon	33.3
Hydrogen	2.2
Oxygen and nitrogen	7.0
Sulphur	1.5
Ash .	6.7
Calorific value	4,916 B.Th.U.

As indicating what can be done with brown coal, reference may again be made to Germany, which country is by far the greatest contributor to the world's output, as the figures for 1924 and 1926 show (p. 154, over).

In Germany in 1923 over 52 million tons of brown coal were briquetted and 14 million tons treated by low-temperature carbonisation for the production of oil and "coke," the remainder being used in the raw state for heating homes or raising steam, and some for the extraction of montan wax.

The world output, by countries, for the years 1924 and 1926, was as follows :

	1924. Long tons.	1926. Long tons.
Germany . . . . .	122,634,103	136,914,209
Czechoslovakia . . . . .	20,130,874	18,218,093
Austria . . . . .	2,741,044	2,910,193
Hungary . . . . .	6,231,501	5,728,448
France . . . . .	947,048	1,039,200
Holland . . . . .	188,129	207,800
Italy . . . . .	902,746	1,162,356
Spain . . . . .	405,155	393,404
Poland . . . . .	86,623	74,804
Bulgaria . . . . .	1,126,766	—
Greece . . . . .	129,002	150,000
Russia . . . . .	1,043,017	1,579,973
U.S.A. . . . .	1,300,000	—
Canada . . . . .	3,182,408	3,210,104
New Zealand . . . . .	988,201	1,043,611
Australia . . . . .	127,490	957,935
India . . . . .	477,946	415,965
Jugoslavia . . . . .	3,988,925	3,986,457
Portugal . . . . .	7,990	17,411
Rumania . . . . .	2,439,241	2,687,465
Russia (Asiatic) . . . . .	595,231	676,788

The great increase in Australia is a noticeable feature.

In this article it is proposed to give a brief account of the several uses to which lignite is applied.

### 1. *The Application of Lignite and Brown Coal to the Generation of Power*

As showing what can be done in this direction one may again turn to Germany. In 1913, 23 per cent. of the electric power generated in Germany was from steam raised by burning raw brown coal or brown coal briquettes, but in 1922 it had risen to 41·2 per cent.; and it is interesting to note that, during the decennial period, 1913–1922, the generation of electric power in Germany trebled.

In the State of Victoria, Commonwealth of Australia, great developments have taken place of recent years in the brown coal industry in connection with the generation of electrical power at Yallourn—about 6 miles from the town of Morwell and 110½ miles from Yarraville, near to Melbourne, which is the terminal station. At Yallourn there is established a 50,000 K.W. station with a stand-by

set of 12,500 K.W. all worked on brown coal. The net calorific value of the raw brown coal is only about 4,800 B.Th.U. per lb. with 50 per cent. moisture and about 3,600 B.Th.U. per lb. with 60 per cent. moisture. It is briquetted, the moisture being reduced to 13 per cent. and the calorific value raised to about 9,000 B.Th.U. per lb. The briquetting works have been constructed to supply a maximum output of 100,000 tons per annum. The deposit of brown coal, from 120 to 180 ft. in thickness, is worked "opencast," the overburden, from 20 to 40 ft. in thickness and consisting of sand, sandy clay and gravel, being removed by mechanical shovelling, as in the case of many of the German deposits.

The briquettes made at Yallourn are equal to the German briquettes; indeed, it is claimed for them that they have from 8 to 10 per cent. higher heating value and have about half the ash-content of the German article.

As has been stated, it is when lignite or brown coal can be supplied more cheaply than true coal that it can be used in competition therewith. Thus, although the relative heat values, boiler efficiencies and selling prices of lignite and true coal in Germany were in 1924 as follows:

	Boiler efficiency.	Minimum Cal. Value. Cal./Kg.	Price at Mine. M/ton.
1. Mid-German raw brown coal . . .	68	2,300	3.25
2. "       briquettes . . .	75	4,500	11.50
3. Ruhr large coal . . .	80	7,500	20.00
4. "       unscreened coal . . .	78	6,500	15.00

yet so low is the cost of getting the brown coal that, as has been shown, it is used in Germany to a very great extent to raise steam for the generation of electricity. Thus the comparative figures are (1924):

Cost of working brown coal . . .	M 2 per ton.
"       "       coal . . .	M 16 "

So that making the necessary discount in respect of the much lower thermal value of the brown coal as compared with true coal, so low is the price of the former, that it is more economic to use it in a power station at or near the mine than the true coal of the Ruhr, but railway transport, if only 25 km., wipes out the margin, and after

a journey of 200 km. the cost for fuel in the form of steam is more than 50 per cent. higher if brown coal is used instead of true coal (see "Profit from Coal," a paper read in Berlin in 1925 by Kurt Loebinger). If the brown coal is briquetted the range is extended.

## 2. *Converting Brown Coal into Briquettes*

A description of the methods adopted in Germany for converting brown coal into briquettes will be found in the *Transactions of the Institute of Fuel*, No. 1, Vol. I, under the heading, "The Occurrence, Working and Treatment of Brown Coal with Special Reference to German Practice," contributed by the present writer, and the method adopted in converting the carbonised Waikato lignite (New Zealand) into briquettes of high calorific value is described by the same writer in his report to the New Zealand Government, in *Bulletin No. 3*, published by the New Zealand Department of Scientific and Industrial Research, 1928, and to them the interested reader is referred for more detailed information.

In Germany it has not been found commercially practicable to convert the carbonised brown coal into briquettes. The ash content of the "coke" is high, and the "coke" itself so soft and friable as to prevent its being made into a good briquette. So the briquettes are made from the raw uncarbonised coal, which is screened, dried down to 12 to 17 per cent. moisture and compressed at a pressure of about 1,200 atmospheres into briquettes. Speaking generally, the calorific value of the briquettes is about double that of the raw coal as mined.

In the case of the lignite from Waikato, the position was quite different; this coal approximates to a pitch coal, being a glossy black sub-bituminous coal with the analysis given on page 153.

The carbonised fuel or "semi-coke" was briquetted at a works near to Charleroi, Belgium, by agglomeration with pitch very much after the manner practised on so large a scale with true coal slack at Cardiff and Swansea. The quantity of pitch used was from 8 to 8½ per cent., which was satisfactory.

The analysis of the briquette was good, viz. :

	<i>Per cent.</i>
Moisture . . . . .	6·10
Ash . . . . .	7·32
Volatile matter . . . . .	13·52
Fixed carbon . . . . .	73·06

The calorific value was 7,504 calories or 13,507 B.Th.U. A cohesion test gave 74·55 per cent. which was also very good. The briquettes withstood weathering well, and the absorption of moisture was very low indeed.

It should be pointed out that, of the 38 million tons or so of briquettes made annually in Germany from the brown coal, rather more than 3 million tons are what are termed "wet briquettes," a simple form of briquette made for local consumption. This is moulded from the raw, undried brown coal which is wetted and moulded in a press—like an ordinary brick moulding press—and cut by wires into bricks which are stored in a drying shed where they are dried by atmosphere drying. They contain about 35 per cent. of moisture and burn well, but do not withstand handling.

### 3. *The Carbonisation of Lignite and Brown Coal*

In these days when we see so much in the newspapers relative to the treatment of coal by low-temperature carbonisation, it is interesting to learn that since the year 1870 a flourishing industry has been carried on in Germany in the treatment of brown coal by that process. The form of oven or retort in almost universal application is that known as the Rolle retort, devised by the late Dr. E. Rolle between 1865 and 1870, and, though efforts have not been wanting to improve this type, it still holds the first place. The retort, which is vertical, contains an inner hollow cylinder composed of cast-iron collars superimposed the one on the other. This is encased in a building of fireclay brick, there being an annular space between the column of collars and the encasement a few inches wide down which sinks the raw brown coal. Encircling this annular space are the heating flues, the whole being enclosed in a block of red brick masonry. The moisture and the gases distilled from the brown coal pass underneath each collar into the hollow



cylinder formed by the column of collars and are drawn off to the condensers.

The following comparative figures relative to the results obtained with German brown coal and Waikato slack may be of interest (for an average analysis, see page 153):

	German Brown Coal. Per cent.	Waikato Slack. Per cent.
Coke residue . . . . .	27.5 to 32.06	57
Tar (by analysis) . . . . .	9.5	6.01
Recoverable in treatment . . . . .	4 to 6 (or 60% as determined by analysis).	3.37 (or 77.21% of the contained amount).
Gas and moisture (of which 53.5 per cent. is water) . . . . .	58 to 60	36.99

As regards an actual case which came under the writer's observation with German brown coal, having an analysis the same as that given on page 153, the following results were obtained :

Throughput of brown coal containing 50 per cent. moisture . . . . .	3-4 tons per 24 hours.
Semi-coke, per retort per day . . . . .	1-1.5 tons or 33 per cent.
Tar (60 per cent. of the yield as determined by analysis) . . . . .	4-6 per cent.
Light oil stripped from gas in proportion to tar . . . . .	16-20 per cent.
Light oil, per retort per day . . . . .	4.4 lb.
Consumption of brown coal for firing . . . . .	2 per cent.

The advantage of the New Zealand Waikato carbonised slack over the German " coke " is that it can be briquetted to furnish a transportable fuel of high calorific value, whereas in Germany, where the brown coal is much further from maturity than the Waikato lignite, the coke residue can only be used in a special form of household store. It has a ready local sale for this purpose at from 10s. to 12s. per ton. It cannot be burnt in the open grate. It might be used as powdered fuel for raising steam, but as such would not fetch more than from 5s. to 6s. per ton.

The most valuable product in the tar obtained from German brown coal is the paraffin wax which it holds in solution. Probably in the case of the tar distilled from British Empire brown coals it would be more profitable either to burn the tar entire as oil, or to extract the tar acids and use them as a preservative of wood, insecticides, sheep dip, etc., and " crack " the remaining oil into light

oils for use in internal combustion engines than to extract the paraffin wax and adopt close refining processes. But into the consideration of this part of the subject there enter so many factors that it cannot be adequately dealt with in a general article such as the present.

In regard to the brown coals of Victoria the following particulars as to the results of distillation tests may be of interest :

Coal.	Gas.	Tar.		Amm. Sulphate.	Coke or Charcoal.
		Hydrated.	Dehydrated		
	<i>Cb. ft. per ton.</i>	<i>Gal. per ton.</i>	<i>Gal. per ton.</i>	<i>lb. per ton.</i>	<i>lb. per ton.</i>
Morwell, open cut .	7,450	11.7	4 to 5	—	755
" " .	10,224	6.5		—	921
" " .	9,670	—		—	—
" " .	8,252	—		—	—
	(Lime-purified)	—		—	—
" " .	—	—	9.0	6.8	—
" " .	—	9.0		5.6	859
Altona .	9,547	—	—	—	—
" .	—	2.7	—	6.88	752
Morwell, open cut .	13,046	7.0	—	9.88	613
Lal Lal, open cut .	9,919	6.0	—	8.80	543
Altona, open cut .	12,108	2.1	—	6.91	621

The resources of brown coal in the various fields have been estimated from borings to be as follows :

	<i>Millions of tons.</i>
Morwell and District . . . . .	5,000
Waralgon and District . . . . .	5,600
Welspool-Gellondale . . . . .	250
Altona . . . . .	100
Lal Lal . . . . .	25
Wensleydale . . . . .	3
	<u>10,978</u>

The character and constituents of the brown coal tars (crude dehydrated tar) are as follows :

	<i>Per cent.</i>
Benzine . . . . .	1.5
Heavy benzine . . . . .	1.0
Light fuel oil . . . . .	36.0
Heavy fuel oil . . . . .	8.0
Light lubricating oil . . . . .	9.0
Vaseline . . . . .	0.8
Paraffin wax . . . . .	2.0
Phenols and tar acids . . . . .	15.0
Pitch . . . . .	—
Coke . . . . .	25
Gas and loss . . . . .	1.7
	<u>100.00</u>

Mention has been made of the Rolle type of oven, in respect of which certain improvements in the cycle of operations have recently been carried out by M. Debauche, of Gilly, Belgium, with the object of effecting a saving in labour. But there are two other types of retort which have quite lately made an appearance in Germany, namely that of the A.E.G. (Allgemeine Elektrizitäts-Gesellschaft), a vertical rotary retort which is the outcome of research and design on the part of the Kohlenveredlung A.C., originally a research company promoted by the A.E.G. some few years ago. This retort has a throughput of 100 tons of raw, undried brown coal *per diem*, and in connection with electrical power stations using brown coal it appears probable that this oven will have a useful and extensive field of application, provided the brown coal is of a lumpy character permitting of its *gradual* passage through the oven.

The other retort is the Lürgi, which is of the stationary type, whereas the A.E.G. retort rotates. It is claimed for this retort that it has a capacity of over 100 tons of raw lignite a day and that its capital cost is low. Though the normal temperature of carbonisation does not exceed 600° C., it can, if so desired, be operated also on what closely approximates to a high temperature process, viz. 900° C. Recently in Canada a commencement has been made in the carbonisation of lignite by this process, and the results obtained thereby will be awaited with interest.

#### 4. *The Extraction of Montan Wax from Brown Coal*

Some brown coals, probably all, contain a substance which the Germans term "bitumen" which they extract by means of a solvent. The coal is first screened and dried and then treated for a period of about three hours with a solution of benzol and alcohol, the residue being subjected to steaming to recover the solution remaining in the coal. The liquid is then distilled by the external application of steam, the spirit and moisture being driven off, the spirit to be condensed and used over again, the residue being a waxy substance known as montan wax, which in the unrefined form sells for about £20 per ton, and in the refined form for over £80 per ton.

Montan wax has many uses, such as in the manufacture of boot and harness polish, floor polish, gramophone records, in sealing wax, and combined with paraffin wax for making a high-class wax candle ; it is also used in certain high-class varnishes.

The coal residue after the extraction of the montan wax is utilised for firing the boilers at the montan wax works.

It does not pay, in Germany, to treat coals for the extraction of the montan wax which contain under 5 per cent. of that substance (bitumen). I am not aware that brown coal has been treated for the extraction of montan wax in any other country than Germany, but the possibilities in this direction would seem to be worth investigation in regard to the brown coal deposits of the British Empire. According to the statement in the Report on the brown coals of Victoria, Australia, in the *Bulletin No. 45* of the Geological Survey of that state, the amount of bitumen contained in the raw brown coal in three localities was low, being as follows :

							<i>Per cent.</i>
Morwell	.	.	.	.	.	.	1.85
Lal Lal	.	.	.	.	.	.	0.85
Altona	.	.	.	.	.	.	1.05

In conclusion, the writer hopes that he has been successful in this short article in bringing before the readers of this BULLETIN the great latent wealth that exists or may exist in the Empire deposits of brown coal or lignite, and in indicating some possible avenues of research in regard to uses to which they may possibly be put.

## NOTES

**The Nipa Palm as a Source of Alcohol in Malaya.**—In an article in this BULLETIN (1922, 20, 315) the possibilities of the nipa palm as a source of sugar and alcohol were dealt with, the information then available being principally contained in reports of investigations carried out in the Philippine Islands.

It has subsequently proved to be for the production of alcohol for power purposes that this palm has attracted most interest, and a summary of a report of the first year's

working of an experimental nipa alcohol plant in British North Borneo was published in this BULLETIN (1925, 20, 175).

The question has also received attention in the Federated Malay States, and some "Final Observations" on the subject are now published in the *Malayan Agricultural Journal* (1927, 15, 420). The observations recorded in this report were made on cultivated palms on the Sungei Burong and Tinggi River Estates.

The yields of juice from a considerable number of spathes on the Sungei Burong Estate are tabulated, and amount with twice-daily tapping to an average of 16.4 oz. or 0.1025 gallon of juice per spathe for each day on which it is tapped. Work on the Tinggi River Estate was directed, as one of its main objects, to ascertaining the number of spathes available for tapping per palm. Observations in this case were not continued long enough for definite conclusions to be reached, but the records indicate that an average of two spathes concurrently in tapping per palm may safely be assumed. On this basis, and taking 200 palms to the acre, the practice now usually adopted, and 340 tapping days in the year, the annual yield of juice would be 13,940 gallons per acre.

A large number of determinations of the sugar and alcohol contents of the juice were made, and the mean "alcohol equivalent" (i.e. alcohol actually present plus alcohol corresponding to sugar content on a 92 per cent. efficiency basis) of the juice was found to be 10.09 per cent., a somewhat higher figure than the yield obtained in actual practice in the Philippines (this BULLETIN, 1922, 20, 321) or than that assumed for purposes of calculation in British North Borneo (1925, 23, 175). On this basis the annual yield of alcohol obtainable per acre is estimated at 1,394 gallons.

In view of the fact that the juice is subject to fermentation immediately it has been collected, the question of preservation has to be considered. Fermentation can be prevented by the addition of either lime or sulphuric acid, the latter being considered the more satisfactory when the juice is to be used as a source of alcohol. But it is now generally accepted that the great bulk of juice to be handled on a plantation would necessitate the use of iron pipe-lines to lead it to the distillery, in which case the addition of either lime or sulphuric acid to the juice would be impracticable. Alternatives are sterile collection and auto-fermentation. If the first of these is to be adopted, glazed vessels, washed every day, would have to be employed for collection, the juice would have to be sterilised immediately

on arrival at the factory, and then inoculated with pure yeast culture to produce alcoholic fermentation. There are several objections to this scheme. Auto-fermentation means allowing fermentation to take place spontaneously. When this happens some acetic acid fermentation occurs, which is objectionable both on account of the loss of alcohol entailed and from the possibility of the acid corroding the iron pipe. As regards the latter point it is thought that after a short time a protective coating would be formed on the iron, but in any case an anti-corrosive paint could be employed. As for the loss, tests showed that the acid in the juice did not average more than about 1 per cent., and it is considered that, in all the circumstances, the most satisfactory procedure would probably be to allow fermentation to occur naturally. The acid would be subsequently removed as acetate of soda or lime.

In the first article in this BULLETIN mentioned above, reference was made to the native custom of kicking each fruiting stalk at intervals before tapping. This practice is known in Malaya as "gonchanging." It seems to be definitely established that it has a beneficial effect, apparently by preventing the cells from hardening and atrophy as the stalk matures. It is started when the fruit-head is fairly well grown, but before the seeds begin to darken. At first the fruit-head is gently shaken once a day, but as it grows larger the treatment is made more drastic till it takes the form of a hard kick or a violent shaking. It is found to be economically unprofitable to increase the period of gonchanging beyond about three weeks.

The report on which the above notes are based is followed (*loc. cit.*, p. 433) by a popular article on "Alcohol Fuel and the Nipa Palm," in the course of which it is pointed out that whereas in the Philippines and British North Borneo the question is one of forest exploitation, nipa occurring naturally over large areas in those countries, in Malaya the palm would have to be grown in plantations on an extensive scale, as has in fact been done on the two estates already mentioned, and treated as an agricultural proposition. It has been found that in Malaya the palm can be tapped all the year round without injury, an important consideration in exploiting it on plantation lines. In the Philippines and British North Borneo on the other hand it only fruits for a period of four to six months in the year.

The planting distance recommended is 12 ft.  $\times$  18 ft. staggered, or 200 to the acre. It is estimated that the cost of bringing a plantation into bearing, at three years, should not exceed \$60 per acre.

**Beetles Injurious to Timber.**—Apart from the termites or white ants which are so destructive in tropical and sub-tropical countries, the most important enemies of timber are various kinds of beetles. A useful account of these latter pests and of the damage caused by them, has been written by Dr. J. W. Munro and published by the Forestry Commission as *Bulletin No. 9*, 1928.

The insects concerned belong to a number of families, which fall under the four following groups.

The Longicorn Beetles (*Cerambycidae*) are essentially forest pests. They attack dying trees and freshly felled logs, but desert the timber as soon as it has become dry; they rarely increase or spread in timber yards. Different species attack different timbers, but almost all trees are liable to attack by one or more species. The damage done is principally to the sapwood. Remedial measures against these beetles must be taken in the forest. One method is, before extensive felling, to cut down a few trees here and there to serve as traps. Felled timber should be removed from the forest as soon as possible. Barking the logs immediately on felling prevents the beetles from laying eggs, though it may be undesirable for other reasons. Spraying has not proved generally effective.

The Pin-Hole Borers (including *Scolytidae* and *Platypodidae*) attack recently felled timber and are more common in hardwoods than softwoods. They do not feed on the wood itself but on a mould or fungus which grows in the tunnels. Owing to the fineness of the holes that they make they do not generally cause any serious mechanical injury to the wood, but they affect its appearance not only by the presence of the pin-holes but also by a peculiar black staining which spreads from the holes. Preventive measures consist in the early removal of felled timber and in the barking of logs. It is also desirable to fell in winter or when the insects are inactive, though in the tropics they are active all the year round.

The Powder-Post Beetles (*Bostrychidae* and *Lyctidae*) attack seasoned timber, their activities being confined to hardwoods. The Bostrychids are mostly tropical or sub-tropical and are not often found in this country. Of the Lyctids the genus *Lyctus* is by far the most important. This is principally found in recently seasoned timber, being most prevalent in workshops and stores containing furniture and other wooden manufactures. It does not attack old furniture. Its effect is ultimately to reduce the whole of the sapwood to powder. All hardwoods are not equally susceptible to attack, close-grained woods being immune. The *Lyctus* beetle has increased considerably in this

country in recent times. To prevent losses caused by this pest the most satisfactory way is, where possible, to eliminate sapwood before using the timber. This is sometimes done in the case of oak and ash to be used for making furniture, but there are economic and, in some cases, technical objections to such a procedure. Sterilisation by heat is commonly employed in the United States, steam kiln-heating to 130°–135° F. being found effective. The process must be applied to all timber brought into a yard, since sterilisation does not confer immunity from subsequent attack, and co-operation by neighbouring timber yards is necessary as the beetles fly readily in warm weather. The possibilities of using insecticides are being investigated by the Forest Products Research Laboratory.

The Furniture Beetles (*Anobiidæ*) attack seasoned timber, and are found in almost all timbers, both coniferous and hardwood, that are used for furniture or structural work. They affect heartwood as well as sapwood, and are not confined to freshly seasoned timber, in fact they appear to have a preference for old wood. The Anobiids include the Common Furniture Beetle (*Anobium punctatum*), the Death-Watch Beetle (*Xestolobium rufovillosum*, formerly *X. tessellatum* F.) which attacks timber structures in old buildings, and other species. To prevent attack by anobiid beetles care should be taken not to introduce infected furniture or wood into buildings, suspected wood being sterilised by heat when possible. Where these beetles are already established chemical insecticides can be applied; the problem is, however, frequently complicated by the inaccessibility of the timber affected and by the necessity for avoiding any treatment that would discolour the wood. Success depends on the thoroughness with which the work is done, and may involve repeated applications over a period of several years. Much research has been done, and much remains to be done, on methods of combating this pest.

**British Empire Vegetation Abstracts.**—The British Empire Vegetative Committee have inaugurated a scheme by which titles and abstracts of publications on the vegetation and ecology of the overseas Empire and on related topics will be published as Supplements to the *Journal of Ecology*. The first instalment, which has been issued as a supplement to the *Journal* for February 1928, covers publications bearing the date 1926. The titles and abstracts will be grouped geographically under the following headings: (1) Canada, (2) South Africa, (3) Australia, (4) New Zealand,



(5) Pacific Islands, (6) Malaya and East Indies, (7) India, Burma and Ceylon, (8) Tropical and North Africa, (9) Central and South America. Of these (1), (2), (3), (4), (5) and (7) are represented in the first instalment.

As indicating the very wide range of subjects dealt with, the following titles of some of the papers and books abstracted may be quoted: "The Vegetation and Retrogressive Changes of Peat Areas ('Muskegs') in Central Alberta"; "The Propagation of 'Stinkwood' (*Ocotea bullata* E. Mey.) by Vegetative Means"; "The Genera of South African Flowering Plants"; "Some Ecological Features in Tasmania"; "Forest-floor Covering and its Life"; "The Altitudinal Distribution of the Ceylon Endemic Flora"; "Loranthaceæ of Southern India and their Host Plants"; "Ferns and Flowering Plants of Mayor Island, New Zealand"; "The Bryophyta of South Africa"; "Fresh-water Algæ from India"; "Descriptions of some previously unnamed South African Fungi"; "Some Aspects of the Virus Disease Problem in Plants"; "Insects in Relation to Plant Disease"; "Biological Notes on New Zealand Heteroptera"; "Phosphorus Deficiency in South African Soils and Vegetation"; "Geology of South Africa."

The Supplements will be issued with the *Journal of Ecology* and will be included in the subscription price of the latter. They will also be supplied apart from the *Journal* at a subscription price of 5s. a year, payable in advance, on application to the Hon. Secretary of the British Empire Vegetation Committee (Dr. T. F. Chipp, 199 Kew Road, Kew, England), from whom full particulars of the scheme may be obtained. Individual Supplements will not be sold separately.

**Mechanical Analysis of Heavy Ferruginous Soils.**—A new method for the "dispersion" or breaking down of soil aggregates into their constituent particles prior to mechanical analysis, by the use of hydrogen peroxide has recently been adopted as the official method of the Agricultural Education Association. It has generally been found, however, that the normal form of this method (treatment with neutral hydrogen peroxide followed by mechanical shaking) is ineffective in giving a proper dispersion of the finer fractions in the case of certain heavy ferruginous soils (probably including those of a "lateritic" type), such as occur commonly in tropical and subtropical localities. The difficulty of obtaining a correct dispersion in such soils has been encountered for a considerable time at the Imperial Institute. An investigation was therefore made to deter-

mine whether a modification of the method could be found which would be applicable to these heavy soils, and the results have recently been published by Miss R. C. Groves, M.Sc., of the Mineral Resources Department of the Institute in a paper entitled "The Mechanical Analysis of Heavy Ferruginous Soils" (*Journal of Agricultural Science*, 1928, 18, pt. 2, pp. 200-205). It was found that the use of hydrogen peroxide containing a small amount of ammonia, combined with repeated gentle rubbing with a rubber pestle until no more clay separated in presence of a few drops of ammonia, was much more successful in giving a proper dispersion in the soil than any combination of neutral peroxide with rubbing or ammoniacal peroxide with mechanical shaking, but without rubbing. Mechanical shaking for 24 hours after treatment with ammoniacal peroxide combined with the repeated rubbing did not affect the dispersion in the soil. It was therefore concluded that the use of ammoniacal hydrogen peroxide combined with repeated rubbing provides a suitable method for the proper dispersion in soils of this type.

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## RECENT RESEARCH ON EMPIRE PRODUCTS

### A Record of Work conducted by Government Technical Departments Overseas

IN the present number, the reports relating to Agriculture and Forestry have been grouped under subjects, instead of under countries as heretofore, and it is hoped that this arrangement will be more convenient to readers interested in a particular product. Reports from the following countries are dealt with: British Guiana, British Honduras, Cyprus, Federated Malay States, Fiji, Jamaica, Gold Coast, Leeward Islands (Antigua and Montserrat), Nigeria, Nyasaland, Seychelles, Sierra Leone, Southern Rhodesia, Tanganyika, Uganda and Windward Islands (St. Lucia). A report has also been kindly forwarded by the Minister of Irrigation and Agriculture, Iraq, on the work of his Department; the information contained in this report is included with the other statements received solely on account of the political and commercial association of Great Britain and Iraq.

## AGRICULTURE

## GENERAL

*Cover Crops*

**Sierra Leone.**—In the cover crop trials at the Njala Experimental Farm, *Calopogonium muconoides* is growing well. Velvet beans have not been successful, as they do not thrive during the wet season; they like to be treated as a short season crop sown towards the end of the rains to mature in a few weeks. Bengal beans so far have proved to be a much more satisfactory "cover."

**Uganda.**—Several species of native Mpindi (*Vigna* sp.) were sown in plot trials at the Serere Experimental Farm during 1927. One of these, "Bimogoti," introduced from Buganda Province, gave excellent results as regards robust growth, resistance to drought and disease, and heavy yield. It is considered that this variety would make a most useful cover crop, as well as being suitable for green manuring purposes. Other varieties were seriously affected by drought in October and only small yields were obtained.

*Irrigation*

**Iraq.**—First experiments on the duty of water have been carried out by the Department of Agriculture during the year on the cotton crop. The average duty of water throughout the season was found to be 68·87 acres per cusec of water. In August this duty rose as high as 52·38 acres per cusec. These are very high duties, due, no doubt, to the high temperatures and low humidity of the summer season. They are the results of first experiments only and will need confirmation in future years.

*Rotation Trials*

**Sierra Leone.**—The rotation trials being carried out at the Njala Experimental Farm are described in the previous half-yearly report (this BULLETIN, 1927, 25, 297). The rice following green manure was a poor crop, but the plot would probably want thorough manuring before it could give a good crop of rice, as it had been long in cultivation with nothing but occasional slight green manuring. The cassava planted in June 1926 yielded 5 tons 4 cwts. 87 lb. It was planted 2 ft. by 2 ft. apart, and two sticks to a place. Pigeon pea was planted after the cassava was harvested and gave a fairly good stand. The cotton after ginger, but preceded in the early part of the year

by a green manure crop, is now a fair stand. The ground-nuts after rice have yielded 23½ bushels.

## SOILS

**Federated Malay States.**—A Division of the Department of Agriculture for the investigation of soils was constituted in February 1927. Except for a brief period in 1913-14 there has hitherto been no systematic soil work in Malaya, and the most pressing need appeared to be work leading to classification of the soils. For this purpose it was decided to carry out a soil survey of an area in Selangor (Cheras-Serdang-Klang-Coast) which has the advantage of including all the important geological formations found on the west side of the Peninsula.

Preliminary experiments showed the Robinson method of analysis to be suitable and this has been used throughout for mechanical analyses. It has been found that treatment with hydrogen peroxide is unnecessary for most of the mineral soils, and this has been omitted when dealing with such soils.

The Government Experimental Plantation, Serdang, is included in this area, and the survey work there has been done in some detail.

The survey has now reached the Ayer Hitam Forest Reserve and a fairly complete idea of the distribution of what may be called the upland soil types in the area chosen has been obtained.

Five hundred and twenty-seven samples representing one hundred and twelve profiles have been collected and mechanical analyses completed. Mineralogical examination of the heavy fractions of a number of these samples, and chemical determinations of the silica/sesquioxides ratio are in progress.

It is proposed to carry out surveys of the padi soils of the country. Samples are being collected with the aid of the Agricultural Field Officers. So far 103 samples, nearly all from Malacca, have been received and subjected to mechanical analysis. One important result which has already emerged is that high yields may be obtained from soils containing a far higher percentage of sand than has hitherto been thought desirable in Malaya.

Observations are in progress on the buffer action of rice soils with a view to confirming (or disproving) the suggestion of Arrhenius in *Soil Science*, vol. xiv.

All soil samples taken are examined for pH value, both in suspensions by the use of the quinhydrone electrode and on the filtered extract, as considerable variation

has been found between the two values (see *Malayan Agricultural Journal*, vol. xv, p. 206).

A number of pot-cultures have been started, with a view to ascertaining the manurial requirements of different soil types ; and also the effect of soil acidity on nodule formations in some of the common leguminous cover plants.

A number of observations on nitrate formation, effect of covers on moisture, moisture coefficients, base exchange capacity, etc., have been carried out.

**Iraq.**—An examination of the results of mechanical analyses of the alluvial soils of Iraq conducted by the Department of Agriculture shows that the fine gravel fraction is absent in most cases, while the coarse sand and clay content is also low. Fine sand, coarse and fine silts are the principal constituents of these soils and according to the proportion of these constituents the soils may be classified as silty or sandy loams.

From the chemical point of view the outstanding characteristic of the soils is their extreme richness in calcium carbonate. The proportion of potash is also high, while with regard to their phosphoric acid content the soils may be classed as normal. The nitrogen content of most soils is poor.

Water-soluble salts are always present. In soils that have been long under cultivation, accumulation of alkali takes place in the soil owing either to (1) rise of alkali from the sub-soil, or (2) the concentration of salts contained in the saline irrigation water. Another frequent source of alkali accumulation is the continuous evaporation of seepage water from the river or from canals. The toxic alkali salts consist of the chlorides of calcium, magnesium and sodium along with the sulphates of magnesium and sodium. Black alkali (sodium carbonate) has not been met with. Soils that have not been under cultivation for any length of time or soils that have been under cultivation for a long period, but which possess good drainage, contain only minute amounts of water-soluble salts.

A type of sandy soil consisting almost entirely of coarse and fine sands with very small amounts of silt is also found in places. Such soils are very poor in plant food constituents and but for the scanty pasturage offered during the winter months have no agricultural importance.

The Department of Irrigation has carried out a preliminary experiment in salt land reclamation in co-operation with the Agricultural Department. This experiment shows that the soil in question washes readily if drains

of suitable depth and spacing are provided. From the beginning of June to the end of August 1927, an average of 62.7 tons per acre of soluble salts were washed out of the top 3 ft. of the soil, of which amount 24 tons were actually traced in the drainage waters. It would appear from this isolated experiment that provided suitable arrangements for disposal of drainage waters were made, the reclamation of the salt lands of Iraq would not present any extraordinary difficulty.

**Nigeria.**—Mr. W. E. de B. Diamond, Agricultural Chemist, reports that the research work on soils during the past year has been mainly directed to an investigation into the influence of green manuring on the maintenance of fertility.

The native farmers in Nigeria usually pursue a system of "shifting cultivation"; that is to say a piece of land is cultivated for about three or four years until it is worked out, the land is then allowed to revert to bush and the farm transferred to newly cleared land. The purchase of artificial manures by the native cultivator is not an economic proposition and experiments have therefore been carried out to test the effect of using green manures to maintain fertility and so overcome the wasteful process of shifting cultivation.

Records of nitrogen determinations on a number of experimental plots have shown that, under the prevailing conditions, the changes in the nitrogen content of the soil are very rapid and extensive: changes of as much as 200–300 lb. of nitrogen per acre per month having been recorded. Such extensive changes have hitherto been quite unexpected so that a totally new light has been thrown on the nitrogen economy of soils under tropical conditions.

While the work is by no means complete, a foundation has been laid on which it will be possible to build up a knowledge of the reactions affecting the fertility of the soil.

A detailed account of the work will be published in due course in the *Annual Bulletin* of the Agricultural Department.

**Sierra Leone.**—Mr. F. J. Martin, Agricultural Chemist, reports that during the last three years soil survey work has systematically been carried out in the Colony and Protectorate of Sierra Leone and about 1,500 samples have been collected by agricultural chemists, superintendents of agriculture and forest officers. The soil, in accord-

ance with instructions issued, is sampled in a uniform manner to a depth of 4 ft. and descriptions of the soil, vegetation and surrounding country are submitted with the samples. Sufficient information has been collected in this way to allow of a very fair idea to be formed of the types and distribution of soils throughout the country, and it is hoped that a soil survey of Sierra Leone will be published some time during 1928.

The composition and properties of laterite and lateritic soils have formed one of the first problems to be tackled by the chemical staff, and as a result of chemical analysis it has been found that the greater part of the soil of Sierra Leone is lateritic, that is, contains a high proportion of alumina to silica. A paper embodying the results of the first stage of this research was published in the *Journal of Agricultural Science* (1927, 17, 530). The composition was given of some Sierra Leone soils and definitions of laterite and lateritic soil discussed. It was shown that certain definitions, however suitable from a geologist's point of view in defining rocks, are not suitable from the soil chemist's point of view in defining soils. It was suggested that, as the clay fraction is regarded as the most important fraction in determining the reactions of a soil, the classification of laterite and lateritic soils should be based on an examination of the clay fraction. It was further suggested that where the silica/alumina ratio of the clay falls below 2.0 the soil should be regarded as lateritic and where this ratio falls below 1.33 the soil should be described as laterite: soils where the silica/alumina ratio of the clay fraction exceeds 2.0 should not be described by any term denoting a high proportion of alumina to silica.

Further investigations show that these soils are low in mineral plant foods as indicated by the amount of phosphorus and potash soluble in hydrochloric acid, while the exchangeable bases are also low, the exchangeable calcium being about 0.08 per cent. in the few samples examined.

### MANURES

**Iraq.**—The great need of Iraq soils is almost universally organic matter. Green manures are indicated, and experiments have been conducted by the Department of Agriculture with a view to ascertaining the most suitable crop to be used for this purpose. The results of these experiments are not yet definite, but so far berseem (*Trifolium alexandrinum*) and the vetch "Heurteman" (*Lathyrus sativus*) seem to be the most suitable.

## BEVERAGES

*Cocoa*

**Federated Malay States.**—Cocoa does not appear to thrive in Malaya, but experiments are being conducted by the Department of Agriculture to test its growth under jungle and when interplanted with sugar palm and limes.

**Gold Coast.**—Mr. C. H. Knowles, Director of Agriculture, reports that major investigations carried out at Experiment Stations during 1927 included determinations of the yields of individual trees of cocoa with the aim of selecting productive strains, and also a continuation of the trials of yields of measured areas of cocoa on each station. In addition, eight plots of a quarter of an acre each were laid down at four Experiment Stations in order to determine the initial errors with a view to using the plots for comparative trials with manures. Full details of these trials are being published as a series of papers in the *Year-book* of the Department for 1927. The ranges of variations of annual individual yields and plot yields were found to be considerable; in the case of one station the yield from single trees varied from nil to 422 pods, whilst that from adjacent quarter-acre plots ranged from 4,272 to 13,644 pods.

Investigation into the correlation between distribution of rainfall and distribution of crop has been carried out, and the results will be published in the *Year-book* for 1927. Investigation of this kind is urgently necessary and will form the basis of accurate statistical and experimental work.

During the whole year a voluntary system of examination of all cocoa exported was carried out at the five ports of the Colony, five major manufacturing defects being taken into consideration. The work entailed the taking and analysis of over 36,000 samples representing over 106,000 tons. A thorough investigation was made into the sources and magnitude of the errors of the methods of sampling involved. The figures of results of port examination are at present confidential, but mathematical papers on the determination of sampling error are being published in the *Year-book* for 1927.

The relationship between moisture content of cocoa beans, humidity of the atmosphere and the occurrence of moulds in the beans has been worked out during the year. In general the hygroscopic moisture in air-dry beans ranges from 6½ to 9 per cent., and this percentage does not appear sufficient to support the growth of moulds to the extent



to which the latter occurs in local shipments. The effect of wetting by sea water, by fresh water, and of allowing excess moisture to remain in the manufactured bean has been worked out and the results are being published in the *Year-book* for 1927.

The life-history of *Sahlbergella*, a local pest of the cocoa plant, has been worked out during the year and published as *Bulletin No. 3* of the Department. A parasite (*Euphorus sahlbergellæ*) of *Sahlbergella*, which, unless under certain conditions, is a partial control of *Sahlbergella*, was discovered and a description published in the *Year-book* for 1926. The life-history of the cocoa pod borer (*Characoma stictographa*) was investigated.

Certain relationships between cushions and pods of cocoa infected by *Phytophthora Faberi* have been worked out and are being published in the *Year-book* for 1927. Another paper will deal with the transmission of fungoid diseases by invertebrates. In addition, investigations were made into the transmission of *Trachysphaera fructigena* on cocoa pods.

During the whole year the Plant Pests Inspectorate worked entirely on cocoa. Demonstrations of the methods of treating diseases and pests were made in every district of the cocoa area. Towards the end of the year a survey of the whole cocoa area was made in order to ascertain the extent to which local farmers have adopted the methods practised and advocated by the Inspectorate. Records are not yet complete.

Comparative trials of dried blood, basic slag, sulphate of potash, and sulphate of ammonia, were laid down by the Department of Agriculture in 1926 at four Experiment Stations in connection with cocoa. The first year's results have shown that in every case the initial variations between plots have been considerable, so that it would be unwise to base any opinion on them. Up to the present there have been no importations of manures by the public, the farmers never having adopted their use.

**Nigeria.**—Mr. T. Laycock, the Senior Mycologist, reports that experiments are being carried out with the object of determining the causes of moulding of cocoa beans. These indicate that fermented cocoa moulds much more rapidly than does unfermented cocoa. The experiments also show that fermented beans reabsorb moisture much more rapidly than do unfermented and the degree of moulding is correlated to the amount of moisture present within the beans. The difference in pH value of the two samples also affects the degree of mouldiness. The un-

fermented beans are much more acid than are the fermented ones (the pH being 3.4 and 4.8 respectively), and this greater acidity appears to inhibit moulding. Experiments with culture media obtained from extracts of fermented and unfermented beans indicate that the different degree of moulding is not solely due to the degree of acidity of the two media, but that the chemical nature of the fermented beans is such that it forms a more suitable pabulum for the development of fungi.

### *Coffee*

**Federated Malay States.**—The work on coffee in progress by the Department of Agriculture consists of:

- (i) Variety trials.
- (ii) An experiment to test the effect of various cover crops on the different varieties.

At Cameron's Highlands (elevation 5,000 ft.) trials of the suitability and yields of Arabica and other varieties are being conducted.

**Leeward Islands. Montserrat.**—Mr. C. A. Gomez, Curator of the Experiment Station, Montserrat, reports that the coffee nurseries of the Station are supplying planting material to growers and already a few trees planted two years ago are coming into bearing. An extension of coffee planting is taking place in the island and should, in time, at least supply all local requirements.

**Nyasaland.**—A new stem-borer of coffee (*Dirphya nigricornis* Oliv.) was bred by the Government Entomologist. This borer tunnels the stem from high up right down to the tip of the tap root. It remains in the stem for one season only.

**Sierra Leone.**—A new scheme of manurial trial has been started on the plantation of *Coffea stenophylla* at the Njala Experimental Farm. There are three plots now under trial. Each plot is divided into three sections. One section on each receives a "complete manure," viz. sulphate of ammonia, potash and superphosphate, and one section on each is a control, but on one plot the third section receives sulphate of ammonia and superphosphate, on another it receives potash and superphosphate and on the third it receives sulphate of ammonia and potash.

**Uganda.**—The overhead shade in the coffee robusta block at the Bukalasa Plantation was considerably reduced

at the commencement of 1927 and this has resulted in a greatly enhanced yield and general improvement of the plot. Four individual trees were selected this season and the seed sown on the plantation nursery beds; the trees were selected for their heavy yielding qualities, size of berry and desirable habit of growth. It is intended to leave the block for another year, and at the end of that time to cut out the non-desirable types, replacing them by the best selections.

### *Tea*

**Federated Malay States.**—Trials of suitability, growth and yields of different varieties of tea are in progress at the Government Experimental Plantation, Serdang, in the plains, and also at Cameron's Highlands. The growth, yield and quality of the Assam varieties planted on the Highlands have up to the present been quite satisfactory.

**Nyasaland.**—Mr. C. Smee, Government Entomologist, reports that young Indian tea attacked by "White Ants" was treated with "Cyanogas" at various strengths, but it was found that a quantity sufficient to kill the termites adversely affected the bushes; nor did ringing unattacked bushes with the material prevent damage being done a month later.

Breeding of *Dicasticus mlanjensis* Mshl., a weevil which, as mentioned in the previous half-yearly report (this BULLETIN, 1927, 25, 311), devours the foliage of young tea plants, was carried on, but it was found difficult to feed the larvæ, which are root borers.

A chalcid egg-parasite was raised.

## CEREALS

### *Barley*

**Iraq.**—Work on similar lines to that referred to under wheat (p. 180) is being carried out by the Department of Agriculture, but is not so far advanced. At present 131 "Iraqi" varieties and 56 imported varieties are under experiment. A good barley for stock feeding for home consumption, and a good malting barley for export are the two objectives in view.

### *Buckwheat*

**Uganda.**—An experiment to determine the optimum rate of seeding for buckwheat was carried out at the Serere Experimental Farm during 1927. Plots of one-

eighth acre were sown on April 26, and harvested on June 27, with the following results :

Plot	Rate of seeding per acre. lb.	Yield per acre. lb.
Plot 1 . . . . .	20	336
" 2 . . . . .	28	336
" 3 . . . . .	36	488
" 4 . . . . .	44	520
" 5 . . . . .	52	1,136
" 6 . . . . .	60	1,184

These results are somewhat similar to those obtained in the previous year's trials.

### *Eleusine coracana*

**Uganda.**—Experiments conducted at the Serere Experimental Station during 1927 with this cereal (known locally as "Wimbi") included trials with four distinct varieties, selected and segregated from the native crop, on quarter-acre plots. The calculated yields per acre were as follows :

Plot No.	Native name.	Yield per acre. lb.
1 . . . . .	Emiroit	104
2 . . . . .	Eteke	300
3 . . . . .	Engenyi	1,528
4 . . . . .	Emoru	1,804

Plots Nos. 1 and 2 were spoiled by a heavy storm after sowing, and much of the seed was probably lost.

Trials carried out with the Eteke variety of wimbi on eight plots each of one-sixteenth acre, sown on February 12 and harvested June 21, to determine the most suitable rate of seeding, gave the following results :

Rate of seeding. lb. per acre.	Yield per acre. lb.	Rate of seeding. lb. per acre.	Yield per acre. lb.
4 . . . . .	1,024	12 . . . . .	992
6 . . . . .	3,104	14 . . . . .	1,392
8 . . . . .	2,432	16 . . . . .	1,824
10 . . . . .	1,536	18 . . . . .	1,072

Although not conclusive, the above figures indicate the superiority of moderate seeding.

Experiments were also conducted to determine the yield of wimbi following fallow and cotton, respectively. The yield after fallow amounted to 1,078 lb. per acre, and that after cotton to 2,270 lb. per acre. The fallow plot was ploughed in autumn and left rough until time of sowing on February 15, when the pulverising harrow was used to produce a fine tilth ; the seed was harrowed in. The cotton plot was sown native-fashion, after the stalks had been removed, on the same date. The superiority

of the cotton plot was entirely due to freedom from weeds, the fallow plot being choked by grass.

In a manurial trial with wimbi (var. Emiroit), on plots of one-eighth acre, cow-dung was applied at the rate of 10 tons per acre. The manured plot gave a yield at the rate of 1,008 lb. per acre, and the unmanured a yield of 992 lb. per acre.

Progeny plots of one-fifteenth acre were planted with twenty-five individual selections made on the previous year's crop. These gave successful results, and yields up to 2,500 lb. per acre were obtained.

### Maize

**Gold Coast.**—The yields of acre plots of maize, established on eight local Experiment Stations, have been summarised by the Department of Agriculture and will be published when complete.

A review of the fungi attacking cereals and other graminaceous plants in the Gold Coast has been made during the year, and is now in the press as *Bulletin No. 10* of the Department.

**Southern Rhodesia.**—The presence of the weevil (*Calandra oryzae*) in maize cobs in the field in July and August has been demonstrated by Mr. A. Cuthbertson, of the Entomological Section of the Department of Agriculture. Infestation in the field was comparatively extensive on some farms in the Mazoe Valley, especially in the Bindura and Shamva areas, that is below 4,000 ft. Over 4,000 ft. the infestation of cobs in the field was much less common. Dumps at all elevations were infested, however. Field infestation was heaviest in parts of lands near grain sheds and sidings where grain is loaded.

The miscible oil " Harbas " diluted one part in twenty-five parts of water proved useful as a contact spray against adult weevils in sheds.

**Uganda.**—Variety trials were carried out at the Serere Experimental Farm during 1927, with Hickory Kings Potchefstroom Pearl and Salisbury White. The plots of a quarter-acre each were sown on March 22 at the rate of 4 lb. of seed per acre, and the crop reaped on July 12 ; the spacing was 1 ft. 9 in.  $\times$  1 ft. 9 in. The calculated yields per acre were as follows :

	Yield per acre. lb. (in cobs).
Hickory King . . .	2,320 (a thin plant)
Potchefstroom Pearl . . .	2,536 (damaged by ants)
Salisbury White . . .	2,940

The effects of lime on maize (var. Hickory King) were determined on plots of one-eighth acre. The lime was applied at the rate of 1,600 lb. per acre on March 23, and the maize sown the same day, the spacing being 1 ft. 9 in.  $\times$  1 ft. 9 in. The limed plot gave a yield of 2,912 lb. (in cobs) per acre, and the unlimed plot a yield of 2,840 lb.

The yield of maize sown at the rate of one seed per hole was 1,664 lb. (in cobs) per acre, as compared with 1,624 lb. per acre, with two seeds per hole. The cobs in the latter case were very small, and the sample was below average.

Individual selections made from the crop of Hickory King in 1926, with two cobs per plant, were sown in progeny rows, and interesting results were obtained for further trial.

### *Millet (Sorghum)*

**Tanganyika.**—Trials have been conducted by the District Agricultural Officer, Morogoro, to ascertain the optimum planting distance for Sorghum. The crop was grown on land previously devoted to cotton distance trials and seed of the Bonganhilo variety was planted on December 22, 1926. The results are tabulated below :

Distance.	Calculated yield per acre.
	<i>Kilos.</i>
3 ft. $\times$ 6 in. . . . .	715
3 ft. $\times$ 12 in. . . . .	615
3 ft. $\times$ 18 in. . . . .	455
Native (broadcast) . . . . .	590
3 ft. $\times$ 6 in. . . . .	550
3 ft. $\times$ 12 in. . . . .	625
3 ft. $\times$ 18 in. . . . .	429
Native (broadcast) . . . . .	325

**Uganda.**—Three varieties of mutama, or tall millet, were grown at the Serere Experimental Farm during 1927, on plots of a quarter acre. The seed was sown broadcast on April 7 at the rate of 4 lb. per acre. The following yields were obtained :

Variety.	Yield per acre.	Date of Reaping.
	<i>lb.</i>	
Native white . . . . .	1,692	25.7.27
Native red . . . . .	2,548	23.7.27
Imported black . . . . .	1,624	7.7.27

### *Oats*

**Iraq.**—Oats are not grown at present in Iraq, barley being the usual grain used for feeding to stock. Thirty-six imported varieties are at present under test by the Department of Agriculture, with a view to finding a variety suitable for cultivation in the country.

*Rice*

**Federated Malay States.**—The work being carried out by the Department of Agriculture on rice, comprising selection, hybridisation, manurial, cultivation and varietal experiments, is being continued. Seed testing and the preparation of herbarium specimens are in progress.

Preliminary work has been commenced for investigations on rice storage, with a view to lengthening the period for which it can be stored without deterioration. These investigations may necessitate a determination of the nature and causes of the deterioration and of the factors favouring it.

**Sierra Leone.**—The plots devoted to the manurial trials on rice at the Njala Experimental Farm, referred to in the last half-yearly report (this BULLETIN, 1927, 25, 296), were harvested with the following results.

Manure.	Section No.	Yield per $\frac{1}{4}$ th acre. lb.	Weight per bushel. lb.
NPK and Lime . . . .	15	104	41 $\frac{1}{2}$
	17	107	42
NPK . . . . .	1	128	41 $\frac{1}{2}$
	8	116	41 $\frac{1}{2}$
NP and Lime . . . .	2	127	42 $\frac{1}{2}$
	9	90	42 $\frac{1}{2}$
NP . . . . .	11	112	42 $\frac{1}{2}$
	18	84	41 $\frac{1}{2}$
NK and Lime . . . .	4	119	41 $\frac{1}{2}$
	6	99	41 $\frac{1}{2}$
NK . . . . .	13	98	41 $\frac{1}{2}$
	20	106	41 $\frac{1}{2}$
PK and Lime . . . .	12	122	41 $\frac{1}{2}$
	19	99	42
PK . . . . .	3	108	41 $\frac{1}{2}$
	10	106	41 $\frac{1}{2}$
Control with Lime . .	7	112	42 $\frac{1}{2}$
	14	96	41 $\frac{1}{2}$
Control (no manure). .	5	123	41 $\frac{1}{2}$
	16	124	41 $\frac{1}{2}$

*Wheat*

**Iraq.**—In connection with the work of the Department of Agriculture on the improvement of wheat in Iraq, 175 Iraqi varieties and 240 imported varieties have been systematically tested for yield, rust resistance, early maturity, drought resistance and other desirable qualities. Up to date the three wheats recommended, and issued (to a limited extent) by the Department, are "Punjab B8" from India, and "Nyngan 3" and "Clarendon" from Australia. These three have all given good results in the

hands of cultivators who prefer them to their local wheats. Breeding work is in progress with the object of producing a wheat which shall be superior to these imported varieties.

Experiments have been made by the Department of Agriculture with a large number of local and imported wheats with a view to finding the most suitable strain for cultivation in certain large areas in Northern Iraq which are suitable for dry-farming. Up to date the two best varieties are Nyngan 3, imported from Australia, and Punjab B8, imported from India. Both these wheats mature well on the limited rainfall of these areas, but Nyngan 3, being distinctly earlier, is the most suitable, since it is more likely to escape damage from the locust pest which does great damage annually. Conjointly with these varietal tests, cultivation experiments have been conducted which demonstrate the enormous value of post-sowing mulchings as an aid to water conservation.

A heavy annual toll of the cereal crop is taken by the two diseases "rust" and "bunt." With regard to the former, rust-resistant varieties can now be obtained in limited quantities from the Department. With regard to the latter, a comparative test of all known methods of bunt control resulted in the adoption of the standard method, in which copper carbonate dust is added to the seed in the proportion of 1 to 500.

Reports on samples of wheat sent to the Imperial Institute in conjunction with these tests have been published in this BULLETIN (1924, 22, 284; 1926, 24, 14).

#### FODDERS

**Federated Malay States.**—Records are being made by the Department of Agriculture of the yields and rate of growth of the following fodder grasses which grow well in Malaya: *Paspalum dilatatum* (Dallis grass), *Panicum maximum* (Guinea grass), *Pennisetum purpureum* (Merker grass), *Panicum muticum* (Mauritius grass), *Pennisetum purpureum* (Napier grass), *Tricholœna rosea* (Natal Red-Top grass), and *Cœlorrachis glandulosa*.

*Axanopus compressus* (Carpet grass) is being tried as a grazing grass for cattle.

#### FRUITS

##### General

**Leeward Islands.**—*Antigua.*—Mr. A. Gallwey, Agricultural Superintendent, Antigua, reports that with a view to increasing the local supply of fruit in Antigua, and also to the possibility of the development of a fruit trade with Canada, several importations have been made of banana



suckers, grafted mangoes, budded Avocado pears, guava plants and various types of papaw, etc. Most of these have been established and distributed freely, while others have been utilised in planting up Government reserves.

### *Banana*

**Federated Malay States.**—A collection of carefully determined local varieties has been established by the Department of Agriculture, from which descriptions of each variety have been prepared. It is hoped that the collection may prove of value in connection with the attempt now being made to obtain a readily marketable type immune to Panama disease. For the same purpose studies of the local distribution of the commoner varieties and of their local diseases are in progress. These investigations are being carried on in co-operation with the Director of the Royal Botanic Gardens, Kew, and with the Imperial College of Tropical Agriculture, Trinidad.

**Fiji.**—According to Dr. J. D. Tothill, Superintendent of Agriculture, the banana beetle, *Cosmopolites sordidus*, is one of the worst pests of bananas in Fiji. An experiment is being conducted by the Department to test the flying powers of this beetle. It appears that the insect can fly but does not normally do so, and it is important to obtain more data with a view to establishing nurseries to provide healthy stock.

Simultaneously, a cleaning-up campaign has been initiated among native plantations. The beetle breeds in the corms of the stumps and prefers such situations to healthy trees. It is thought that the destruction of the old stumps may assist in reducing the beetle injury and their destruction is therefore an essential feature of the campaign.

**Jamaica.**—According to the *Annual Report of the Department of Science and Agriculture* for the year 1927, the exports of bananas from Jamaica during the year reached a total of 21,074,612 stems, an increase of over 3,000,000 stems as compared with the previous record of 1926. But for the autumnal gales which destroyed two million stems of fruit, it is thought that the banana crop of 1927 would have passed the 23 million mark, the figure which, it is expected, will be reached during the present year. The fight against Panama disease in the island was continued and with an increased staff of eighteen inspectors it was possible to supervise the chief banana areas; in all, 40,000 diseased plants were dealt with during the year. The parish of Portland continues to supply over 70 per

cent. of cases of this disease. Commercial cultivation of the "immune" Robusta banana has commenced on clay lands in St. Mary infected with Panama disease and from one estate the fruit from 5 acres of this variety was successfully shipped and sold.

The banana breeding experiments, which are now under the control of the Government Microbiologist, are stated to be reaching an interesting stage. Their object is to produce a variety of banana, resistant to Panama disease and at the same time bearing a fruit suitable for carrying to overseas markets. The first experiments were made by crossing *Musa Kewensis* (a seedling, non-edible species with good conformation of bunch and fingers) with various edible bananas. These hybrids have grown slowly and appear to require from 3 to 4 years to attain the fruiting stage. On the other hand, a number of hybrids between edible species have grown so quickly that fruit may be expected in  $2\frac{1}{2}$  years from sowing the seed. The variations in seedlings from the same cross are marked, and it is hoped that continuous efforts in the raising of cross-fertilised banana seedlings will eventually furnish the immune commercial banana required to solve the Panama disease problem.

It is stated that a special banana breeding station, preferably in St. Catherine, is necessary, where the new bananas can be tested under commercial conditions and any promising kinds propagated for distribution to planters. The following "immune" bananas are now under trial: China, Robusta, Bumelan and Lacatan.

**Sierra Leone.**—The locally discovered banana which appeared to be similar to the Philippine variety known as Lacatan, which is immune to Panama disease (see this BULLETIN, 1927, 25, 298), has proved not to be immune to this disease.

#### *Citrus*

**British Honduras.**—Special investigation is being made by the Forest Department into the conditions for cultivation of grape-fruit and its shipment overseas. This fruit has been shipped to London with a large measure of success during the past three years. The chief adverse factor is a disease known as Stem-end Rot (*Phomopsis* and/or *Diplodia*) which attacks the fruit and is believed to be controllable by spraying. (See also this BULLETIN, 1928, 28, 75).

**Gold Coast.**—The cultivation of limes is not yet of any importance in the Gold Coast, but about 500 acres have been established by farmers in the Central Province, and

it is possible that a useful small industry may later develop. Departmental investigations during the year have been limited to the determination of the acre yield of a measured plot established in 1912-16. The recorded yield is 174 barrels of 160 lb. each, a figure comparable with good lime plantations in the West Indies.

**Leeward Islands.—Dominica.**—Mr. F. H. S. Warneford, Acting Superintendent of Agriculture, reports that Dominica is the centre of the lime industry of the Colony, and the chief investigation undertaken in connection with this crop is the breeding and testing of varieties immune to withertip, a disease which has seriously attacked limes in that island.

Bud wood of several varieties stated to be immune was imported into Dominica, and small experimental plots of these established. Up to June 1927 the following varieties were found to be the most promising of those tried: Bear's Seedless, Tahiti and Woglums lime. Unfortunately, since that time experience has shown that all three of these possess disadvantages which render them unfit as substitutes for the West Indian lime.

During the year 1927 the Dominica Department of Agriculture has carried out a considerable amount of hybridisation work. It is hoped that some of the hybrids between the West Indian lime and the immune varieties may possess the characteristics required.

In connection with the lime industry an investigation has been carried out at the Federal Government Laboratory on the preparation of pectin from lime skins. The Imperial Institute has been freely consulted on this subject and a stage has now been reached where further laboratory work promises little advantages. The question of preparing lime pectin on a semi-commercial scale has been referred to the Government of Dominica.

**Sierra Leone.**—Manurial trials on the Dominican limes were commenced at the Njala Experimental Farm in August 1925. Section 1 was dressed with 1 cwt. of sulphate of ammonia, 3 cwts. of superphosphate and 4 cwts. of potash; Section 2 was dressed with 24 cwts. of lime, and Section 3 was left unmanured as control. A further dressing of these manures in the same quantities was applied in June 1926. In 1927 there was no further application of the manures. The yields in bushels per 100 trees from the three sections were:

	Section 1.	Section 2.	Section 3.
1926 . . .	377·25	121·25	115·40
1927 . . .	571·43	327·75	373·56

The whole plantation was thoroughly pruned in February 1926; this pruning certainly improved the trees and therefore helped the yields.

A new manurial scheme has just been started: Section 1 now receives 1 cwt. of sulphate of ammonia, 3 cwts. of superphosphate and 4 cwts. of potash; Section 2 receives 1 cwt. of sulphate of ammonia and 4 cwts. of potash; and Section 3 is the control as before. Half of each of these sections have been thinned so that the trees are 30 ft. apart instead of 15 ft.

A supplementary manurial trial has also just been started on the Sierra Leone lime plot. Section 1 receives the same dressing of manure as Section 1 on the Dominican lime plot, but Section 2 receives 1 cwt. of sulphate of ammonia and 3 cwts. of superphosphate; Section 3 is the control.

**Windward Islands.**—*St. Lucia.*—Mr. E. A. Walters, Agricultural Superintendent, reports that raw lime juice was found to exhibit serious discoloration on keeping prior to shipment to the United Kingdom. The samples (10 in number) showed a pale brown colour with a little brown sediment.

Professor F. Hardy, of the Imperial College of Tropical Agriculture, Trinidad, examined the samples and reported that he considered the discoloration to be due to oxidation of the colouring matter of lime-rind, probably through over-exposure to the air, and that such exposure could be lessened by (1) a covering of pulp scum, (2) complete filling of casks, (3) the presence of adequate essential oil content, and (4) rapidity in handling and transporting the product.

The samples were compared with fresh Trinidad hand-expressed lime juice (limes under-ripe), using dilute ferric chloride solution, and the results showed that all the St. Lucia samples submitted contained approximately the same amount of colouring matter, and that each contained four and a half times as much colouring matter as the hand-expressed fresh Trinidad juice. This suggests, in Professor's Hardy's opinion, either that the St. Lucia limes differ in composition from the Trinidad limes used and were possibly over-ripe, or that the limes were subject to too high a pressure in the mills.

Even a trace of iron derived from the mill-rollers greatly enhances the brown discoloration of lime-juice.

The samples examined by Professor Hardy showed an average acid content of from 12.6 to 13.9 oz. of citric acid per gallon.

The samples could be cleared by cold filtration, using "Filter-cel," or a mixture of "Filter-cel" and "Norit," though such treatment may remove essential-oil flavouring matter and therefore be inadvisable.

Professor Hardy concludes his report with a reminder that satisfactory results can only be arrived at by investigation on the spot.

In commenting on this report Mr. Walters mentions that, in the first place, the limes are carefully selected, and over-ripe limes are sorted out for use in the manufacture of concentrated lime-juice, and secondly, that mill pressure is carefully graded to allow of a medium pressure only according to the terms of the buyer's contract with the producer.

Other factors being accounted for, the conclusion appears to be that a slight trace of iron resulting from the use of iron rollers, together with the daily opening of the punchions awaiting shipment in order to allow of the escape of air expanding owing to the heat, might cause the browning of the lime-juice. The problem is further complicated, however, by the action of fruit-flies invading the scum covering the lime-juice in store, with the introduction of the yeasts associated with these flies.

Further attention to this problem will be possible if the new crop is affected, by examination of the process of manufacture step by step.

#### LEGUMES

**Tanganyika.**—Experiments have been conducted by the District Agricultural Officer, Morogoro, to ascertain the relative value of various legumes as crops for production of food, when planted towards the end of the rainy season. The crops were planted on April 25, 1927, on Block A, Range A—Plots 11 to 25. The land had been cropped previously in 1926 with Sorghums.

The periods of maturity and the yields of the different crops are shown in the following table :

Variety.	Period of maturity first to final picking. <i>Days.</i>	Calculated yields per acre. <i>Kilos.</i>
Velvet Beans . . .	125 to 171	657·5
Lima Abundance . . .	103 to 164	350
Madagascar Butter Beans . . .	103 to 164	130
Native Kidney Beans . . .	68 to 80	107·5
Gram (black) . . .	81 to 109	106·5
Gram (green) . . .	70 to 139	31·3
Cowpeas . . .	81 to 140	15·5

*Velvet Bean.*—This crop was grown from seed introduced from South Africa.

It has yielded very well, and if natives can be persuaded to grow it as a food crop, there is a place for it in the agriculture of the Morogoro district. There are no cattle in this district, so its introduction as a cattle food is to no purpose. As a cover crop it makes excellent growth, but unless the bean itself is palatable, there appears to be little hope of its cultivation by natives. Small quantities have been issued as extra rations to labourers, but with their usual conservatism the majority refused even to give it a trial. Those who tried it have reported no ill effects. A quantity is being supplied to the Medical Officer for his observations.

*Lima Bean var. Abundance.*—This bean has yielded consistently well for several seasons, and it is considered that it can now safely be introduced into native and non-native cultivation in the Morogoro area, with every confidence of success.

*Madagascar Butter Bean.*—This bean is very similar to Lima Abundance, but the yields are consistently lower, as shown below :

		1926.	1927.
Lima Abundance	. . .	222.5	350 kgs. per acre.
Madagascar	. . .	72.5	130 „ „

The District Agricultural Officer is of opinion that there is little practical difference in the growth of these beans : if anything, Madagascar makes more vegetative growth. It would be wise to concentrate on Abundance, and to cease to cultivate Madagascar Butter Beans.

*Native Kidney Bean.*—This is the name given to the locally grown miscellaneous coloured unsegregated strains of kidney bean, *Phaseolus vulgaris*. Yields with this bean, not grown in the hills, are usually low, but its value to natives lies in its early maturity. In this connection it features in short rain trials.

*Phaseolus radiatus.*—This crop was grown from seed introduced from Surat and grown for one season at Morogoro. It is a black seeded "gram" and was introduced as insect-resistant, and suitable for storage. In the field it certainly withstood the attacks of aphids much better than the local gram. In yield it has compared favourably with local gram for two seasons and it is considered that it is safe to grow it on substations. A sample has been given to the Entomologist for his observations on it in storage.

*Gram and Cowpea.*—The yields from these crops in the experiment were insignificant, chiefly because of a severe attack of aphids late in the season.

**Uganda.**—Variety trials with 21 different types of beans (*Phaseolus* sp.), comprising many native types from different parts of the country and some importations, were conducted during 1927 at the Serere Experimental Farm to determine the kinds best suited to the soils and climate of Teso. Plots of one-tenth acre were sown on August 2, in rows, with a spacing of 1 ft. 3 in.  $\times$  1 ft. 3 in., and harvested on October 11, with the following results.

Yield per acre.				Yield per acre.			
lb.				lb.			
No. 1	.	.	30	No. 12	.	.	20
" 2	.	.	70	" 13	.	.	280
" 3	.	.	200	" 14	.	.	290
" 4	.	.	180	" 15	.	.	240
" 5	.	.	90	" 16	.	.	130
" 6	.	.	160	" 17	.	.	70
" 7	.	.	10	" 18	.	.	130
" 8	.	.	270	" 19	.	.	170
" 9	.	.	270	" 20	.	.	270
" 10	.	.	150	" 21	.	.	70
" 11	.	.	100				

Some of the plots were badly affected by a wilt disease (identified by the Mycologist as probably *Fusarium martii* var. *phaseoli*), which accounts largely for the low yield. Variations in quality of soil also no doubt had an appreciable effect. Nos. 3, 4, 6, 9, 13, 14, 15, 18, 20 and 21, which showed more robust growth and freedom from disease than the others, are being retained for further trial.

A one-acre plot of white navy bean, sown on August 4 and reaped on October 11, yielded 300 lb. The *Fusarium* disease referred to above caused considerable damage to this plot.

A quarter-acre plot of Canadian Wonder bean sown broadcast on August 5, and reaped on October 24, yielded 100 lb.

#### ROOT CROPS

##### *Cassava*

**Federated Malay States.**—The results so far obtained by the Department of Agriculture from trials of different varieties of cassava were published in the *Malayan Agricultural Journal*, vol. xv, No. 2, p. 41. The trials are being continued.

It is commonly believed in Malaya that cassava (tapioca) rapidly exhausts the soil. Experiments are being conducted to test this and to ascertain the best method of treating land in order to maintain its fertility in respect of this crop. These investigations have necessitated determinations of the quantities of potash, phosphate, calcium and nitrogen in numerous samples of tubers, stems and leaves at different stages of growth. In this connection

a study has been made of the methods of sampling a standing crop, such as tapioca, and advice on this subject has been obtained from the Rothamsted Experimental Station. The preliminary results will be published in the *Malayan Agricultural Journal*.

**Sierra Leone.**—Manurial experiments with cassava have been carried out at the Njala Experimental Farm. The cassava was planted in October 1926 on thirty-six one-eighth acre sections, seven different manurial treatments being tried. The yields from the different sections were as follows :

Manurial Treatment.	Yield per one-eighth acre.			
	Section 1.	Section 2	Section 3	Section 4.
	<i>lb</i>	<i>lb</i>	<i>lb</i>	<i>lb</i>
No. 1. Lime, 2 tons per acre	1,758	1,366	1,458	1,048
No. 2. Pitstuf, 20 tons per acre	1,756	964*	1,502	1,367
No. 3. Lime, 2 tons per acre Pitstuf, 20 tons per acre	1,147	889 (" germination " poor)	1,142	1,075
No. 4. Potash, 2 cwts. per acre	1,562	1,640	1,270	1,309
No. 5. Lime, 2 tons per acre Pitstuf, 20 tons per acre Potash, 2 cwts. per acre	1,366	1,230	1,390	1,100
No. 6. Lime, 2 tons per acre Pitstuf, 20 tons per acre Sulphate of ammonia, 2 cwts. per acre	808*	1,563	1,599	1,360
No. 7. Lime, 2 tons per acre Pitstuf, 20 tons per acre Sulphate of ammonia, 2 cwts. per acre Superphosphate, 2 cwts. per acre	609*	1,560	1,463	1,555

\* Section badly damaged by baby hippopotamus.

Eight control sections which received no manure gave the following yields :

Yield per one-eighth acre.		Yield per one-eighth acre.	
	<i>lb.</i>		<i>lb.</i>
No. 1 . . .	1,394	No. 5 . . .	1,448
" 2 . . .	1,534	" 6 . . .	1,092
" 3 . . .	1,494	" 7 . . .	974
" 4 . . .	1,386	" 8 . . .	478
			(" germination " bad)

The quality and general appearance of the cassava were good.



*Sweet Potatoes*

**Leeward Islands.**—Mr. A. Gallwey, Agricultural Superintendent, Antigua, reports that at the instance of His Excellency the Governor, the question of the development of an export trade in sweet potatoes from Antigua to Canada was raised. After several experimental shipments had been made to England and Canada, it was found that the local types were unsuitable for these markets. Accordingly types of the New Jersey sweet potato, as imported into Canada, were obtained and nurseries formed. This potato is a yellow-skinned variety and a heavy cropper. It matures in from  $3\frac{1}{2}$  to 4 months. Areas have since been planted in this type from the nurseries at the Botanic and Experiment Stations, and larger trial shipments will be made to Canada later in the year.

*Yams*

**Nigeria.**—At various times in the years 1924–26 reports had been received from the Benue and Benin Provinces and Afikpo that beetles were causing severe damage to the yam crop. Early in May 1927 the Senior Entomologist, Mr. F. D. Golding, proceeded to Benin City and the Entomologist, Mr. O. B. Lean, to Abagi in the Benue Province, with the object of investigating the bionomics of this yam pest in the two areas. The same beetle, viz. *Heteroligus claudius* Klug. (Dynastidæ), was found to be responsible for the damage in the two localities.

The results of the investigations are summarised below :

1. *O. B. Lean in the Benue Province.*—A study of the distribution of the beetles showed that in the southern districts of the area visited the pests were unknown, whereas in the northern districts the damage to the yam crop was so serious that in some years famines had resulted. No variation in the vegetation or physical geography of the immune and infested belts was apparent, but a difference was observed in the agricultural methods employed by the farmers of the two belts. In the northern (infested) belt, after the yams have been harvested, the heaps are left undistributed and bullrush millet seeds are sown upon them; the heaps are not broken up until the millet is harvested, when Guinea corn (*Sorghum*) is sown broadcast over the farms. In the southern (immune) belt the bullrush millet is sown broadcast and the yam heaps are scattered over the seeds. In these southern districts the farmers make much more effort to plant their yams before the first rains, whereas further north many farms are planted well into the rainy season, and as late as May

and June. Consequently the yam harvest is considerably earlier in the south than in the north.

Prior to Mr. Lean's departure from the Benue Province in September no sign of the larvæ of *H. claudius* had been seen, but in November females, brought to Ibadan by Mr. Lean, laid eggs in the soil in their cages. The resultant larvæ subsist largely on vegetable matter in the soil; at the time of writing they have attained a length of nearly two inches. It seems probable that the females lay their eggs in the yam heaps.

Mr. Lean has found the adult beetles to be very long-lived, having a longevity often exceeding five months in the case of females, and considerably more in the case of males.

With regard to the control of *H. claudius*, Mr. Lean has selected an area of approximately 49 square miles in the northern belt, and has made arrangements for southern agricultural methods to be adopted in this experimental area in 1928. These, as already stated, consist of early planting and scattering of the yam heaps. In addition, arrangements are being made to test the efficacy of trap crops.

2. *F. D. Golding in the Benin Province*.—A number of districts were visited in the Benin and Warri Provinces, but *H. claudius* is usually a serious pest of yams only in the vicinity of Benin City and at Auchi.

At Benin City the farmers have adopted late planting as a method of control, for experience has taught them that early-sown yams are severely attacked, whereas yams sown in late May or June escape damage to a great extent. The chief drawback to late sowing is that, in some years, a very poor crop of seed yams is obtained. In the partially immune areas visited sowing was carried out, in most cases, from March to early May.

The subject of the distribution of *H. claudius* in these Provinces and elsewhere in the Southern Provinces of Nigeria might well repay further study.

## SUGAR

### *Cane*

**Iraq**.—Experiments with a number of varieties of sugar-cane have been conducted by the Department of Agriculture over a number of years. The growing period would appear to be too short to allow of complete maturation of the canes. Canes begin to grow freely only in June, and are liable to be killed off by cold in November or early December. Only in very exceptional years have canes with a reasonably high sugar percentage matured.

It would appear that the canes grown in the past and referred to in certain literature were for eating purposes only.

**Jamaica.**—According to the *Annual Report of the Department of Science and Agriculture* for the year 1927, the sugar planters of the Colony, with very few exceptions, are recognising the importance of removing all plants showing signs of mosaic disease, with the result that this disease is now on the decline. Westmoreland, for example, which was heavily infected a few years ago, now has only about a 1 per cent. infection, owing to vigorous and continuous roguing. Several estates, which were obliged in the earlier period of the outbreak of mosaic disease to plant Uba cane to assist in the control of this disease, are now gradually discarding this variety and planting the better kinds, such as B.H.10 (12) and Ba. 11569. During the year the Experiment Station distributed 100,544 tops and cuttings of the former variety, and 38,958 of the latter, and only 5,509 of Uba. Ba. 11569, which appears to prefer a friable loamy soil, gave a yield of 70 tons of canes per acre on a 15-acre field in Vere. B.H.10 (12) has also given wonderful results, and it is anticipated that this variety will be the premier variety of the island in a few years; it ratoons well, and when conditions are suitable the results, as ratoons, are as good as plant canes.

Since 1901 co-operative field experiments with fertilisers have been carried out on sugar estates all over Jamaica, and a summary of the results obtained is given by Mr. H. H. Cousins, Director of Agriculture, in the *Annual Report* of his Department for 1927 (pp. 37-41). The general conclusion reached from a study of the 25 years' work is that under conditions of inadequate rainfall, where irrigation is not available, the expenditure of money on fertilisers is a gamble against the weather, and in such conditions mulching is more valuable than manuring with artificials. On the other hand, where irrigation or a favourable rainfall enables large yields of cane to be produced, the use of fertilisers ceases to be a gamble and is a good commercial proposition, and planters now use them regularly.

The following are the chief results arising from these experiments in respect of the different manures.

Half a ton of slaked lime per acre every third year has given profitable increases of cane on many soils, whilst pulverised limestone has also proved satisfactory, where cheap power is available for grinding the limestone. An occasional application of "marl" has also proved beneficial on many estates.

Where the conditions of growth enabled the crop to

develop, the application of 100 to 300 lb. per acre of nitrate of soda or sulphate of ammonia has been generally profitable and on some soils no other fertiliser has given such good returns. In soils deficient in lime, nitrate of soda has given the best results, but on the majority of soils sulphate of ammonia appears to be the most successful form of nitrogen to be applied to sugar-canes in Jamaica. Experiments with "nitrolim" and "ammophos" are still in progress and no conclusions regarding these fertilisers can yet be given.

Phosphates proved to be only rarely profitable when applied to sugar-cane in Jamaica. Basic slag frequently gave good results, but it was subsequently found that this was due to the lime present.

Although on some estates the application of potash has not proved profitable, in other cases the addition of this constituent is absolutely necessary, and generally speaking  $\frac{1}{2}$  to 1 cwt. of sulphate of potash (50 per cent.) is recommended as an addition to the nitrogenous manure.

Mr. Cousins considers that tillage and drainage are of more importance as affecting the sugar crop than the application of fertilisers and points out that no expenditure on manuring can make up for defective cultivation or rectify unhealthy soil conditions brought about by lack of drainage.

**Leeward Islands.**—Mr. F. H. S. Warneford, Acting Superintendent of Agriculture, reports that sugar is the chief crop in Antigua and St. Kitts, and is a minor crop in Nevis and Montserrat. For several seasons varietal experiments have been conducted in these islands, but for the period under review (January to June 1927), the results are available only from Antigua, the St. Kitts-Nevis experiments having been suspended temporarily on account of an outbreak of gumming disease.

**Antigua.**—For many seasons it had been customary to grow a rather large number of varieties in unreplicated one-fortieth acre plots at eight or nine stations scattered about Antigua, but in the seasons 1925-26 and 1926-27 this system was changed. There are three main types of soil in the Island—a rather light calcareous soil in the north and east parts, a heavy clay in the middle and a volcanic soil in the south and south-west. It was decided in 1925 to conduct varietal trials at three stations only each season, one on the calcareous soil, one on the clay soil, and one on the lighter volcanic soil. It was also decided to include fewer varieties and to grow larger plots, quarter or one-third acre each. The plots still remained unreplicated.

In the season 1925-26, which was very dry, experimental plots were grown only at the volcanic soil station. The best varieties, arranged in order of tonnage of canes, were: Coimbatore 221, Ba. 11569, B. 4596, B. 6308. In order of sucrose per acre the best varieties were: Ba. 11569, B. 4596, Co. 221 and B.H. 10/12.

In the season 1926-27, which was unusually wet, variety trials were made at two stations—the calcareous soil station and the clay soil station.

The following table shows the best varieties at these stations.

Calcareous soil.		Clay soil.	
Canes arranged in order of tons cane per acre.	Canes arranged in order of pounds sucrose per acre.	Canes arranged in order of tons cane per acre.	Canes arranged in order of pounds sucrose per acre.
B. 6308 . .	White Transparent	B. 3412 . .	Ba. 11569
B.S.F. 12/24 .	B. 6308	Ba. 11569 .	S.C. 12/4
B.S.F. 12/34 .	Ba. 11569	Ba. 6032 .	B.H. 10/12
H. 1237 . .	B.S.F. 12/24	B. 6308 . .	Ba. 6032

During the season under review ratoons were grown on the plot used for plant canes in the preceding season. The best canes were: Co. 221, Co. 214, B. 6308 and Ba. 11569 in order of tons of cane and B.H. 10/12, B.S.F. 12/27, B. 3922 and B. 4507 in order of sucrose per acre.

The following additional particulars regarding work on sugar-cane in Antigua for the period January to June 1927, have been furnished by Mr. A. Gallwey, Agricultural Superintendent.

Efforts were made to raise new seedling canes and several boxes of seed of known varieties were sown. These gave good germination results. The seedlings were, however, washed away by heavy rains and so the experiment failed. It is evident that, for the successful raising of new sugar-cane varieties, properly equipped glass houses and nurseries are requisite.

After careful observations, it was estimated that the approximate annual loss to the sugar-cane crop due to moth borer (*Diatraea saccharalis*), on a conservative basis, is 10 per cent. In view of this loss, Professor Ballou, Commissioner of Agriculture for the West Indies and Professor of Zoology and Entomology of the Imperial College of Tropical Agriculture, recommended the introduction of types of Braconid parasites, *Ipobracon* and *Microdus* (parasitic on the larvæ of the moth borer), from British Guiana. One introduction was made, to be followed by subsequent ones later in the year.

A supply of insects was received and kept confined in a specially erected cage for breeding purposes. This experiment did not prove a success, one of the chief difficulties being to obtain a sufficient supply of larvæ of the moth borer for the parasites to lay their eggs on, at that period of the cane-growing season. Further importations will be made and it is proposed to liberate the greater portion directly among young growing canes, reserving a small number for breeding purposes in the cage.

The natural food of these parasites is the secretion of nectar found on the leaves of the plants *Cordia interrupta* and *C. aubletii*. These have been introduced through Professor Ballou and plants of both varieties are to be planted on the borders of the cane fields in which the parasites are to be liberated.

**Windward Islands.—St. Lucia.**—Mr. E. A. Walters, Agricultural Superintendent, reports the results of an investigation of molasses, which were found to produce only 77 per cent. of the normal return of rum after fermentation.

Samples of vacuum-pan molasses were examined by the Sugar Technologist, Professor W. Scott, of the Imperial College of Tropical Agriculture, Trinidad, who reported that both samples showed evidence of fermentation when opened.

After fermentation, using portions of each sample, a cloudy, fluorescent precipitate was produced in the rum distilled therefrom when diluted with water. This precipitate was present in samples of rum sent from St. Lucia for examination at the same time as the samples of molasses were sent.

The Sugar Technologist reported that the organism responsible for the faulty rum would be present in the molasses in storage, and that it could be destroyed by heating the molasses to boiling point.

The molasses should be stored in tanks freshly disinfected with ammonium fluoride, boiling water, or the less effective milk of lime; special attention should be given to the disinfection of the distillery and the plant, particularly the underground pipes, etc. The initial wash should then be set up with molasses free from the organism referred to above.

Dr. Briton-Jones, the Mycologist of the Imperial College of Tropical Agriculture, who also assisted in the investigation, suggested that the fresh vats should be started by pitching from the actively fermenting vat.

Samples of rum giving a cloudy precipitate on dilution

with water were also examined by the Sugar Technologist. The precipitate was found to distil over between  $80^{\circ}$  to  $84^{\circ}$  C., and also passed through the finest filter paper used, and did not settle. It was recommended that any faulty rum in storage could be rectified by distillation, discarding the fraction between  $80^{\circ}$ – $84^{\circ}$  C.

Attention to the suggestions regarding molasses should correct the defects in manufacture.

### *Beet*

**Iraq.**—An experiment with sugar-beet has been conducted by the Department of Agriculture with results which indicate that this crop is not likely to be successful in Iraq. The sugar content is on the low side, and the beets tend to be malformed under irrigation conditions.

## VEGETABLES

### *Onions*

**Leeward Islands.**—Mr. A. Gallwey, Agricultural Superintendent, Antigua, reports that onions grown in the Leeward Islands are raised from seed imported from Teneriffe and, owing to the lengthy transportation, the crop often matures too late to be marketed with advantage. Experiments have, therefore, been conducted to test the viability of the seed stored with quick-lime or fused calcium chloride. Seeds so stored in 1925 were sown in May 1926, and germinated well. A one-tenth acre plot at the Antigua Experiment Station was planted with these seedlings in June, and when reaped in October 1926 yielded 212 lb., or at the rate of 2,120 lb. per acre. Encouraged by these results, planters have deposited in this season a considerable percentage of their imported seed for storage at the Federal Laboratory.

## OIL-SEEDS

### *Coconuts*

**Federated Malay States.**—Selection, manuring and cultural experiments, conducted by the Department of Agriculture, are being continued at the Coconut Station, Klang. Records made for the last seven years have shown that some individual palms consistently give a high yield of nuts, while others as consistently give a low yield, the variation in this respect ranging from an average of 114 nuts per annum from the highest yielding palm to as few as 9 nuts per annum from the lowest yielder. These records of variation in yield are being continued and correlated with variation in copra content of the nuts,

and with oil content of the copra from individual trees (see *Malayan Agricultural Journal*, vol. xv, No. 11, p. 387). Investigations have been undertaken to ascertain how far the alleged inferiority of Straits copra is due to natural conditions, local methods of preparation or imperfections in marketing. The preliminary work is concerned with the collection of data relating to the oil content of standard local produce.

**Fiji.**—According to Dr. J. D. Tothill, Superintendent of Agriculture, the control of the Levuana moth has been a major project of the Department since January 1925. The introduction of the Tachinid fly, *Ptychomyia remota*, from the Federated Malay States appears to have brought about the effective control of an insect that threatened to extinguish the copra industry of this Colony. The fly is now maintaining itself on several secondary hosts and remains well distributed despite the scarcity of Levuana. The final report of this project is now in preparation.

In connection with the work on the control of the coconut scale, *Aspidiotus destructor*, a predaceous coccinellid beetle (the name of which is not yet known) was introduced during 1927 from Java. This has now been distributed throughout the scale-infected islands, but it is too early yet to report on its value. Three other species of coccinellids that feed on this scale are now being collected in the West Indies by Mr. T. H. C. Taylor, and were being brought to Fiji in March 1928. When these additional species have been multiplied and distributed it is hoped that a sufficient check against this scale insect will have been established.

The coconuts grown in Fiji have been obtained for the most part from the common wild stock and very little attention has been devoted to seed selection. With a view to making better types available for future planting, an officer of the Department, Mr. H. Marechal, has devoted full time during the past year to making reciprocal crosses between a few selected trees. In the humid climate of this Colony coconut pollen does not retain its vitality long under natural conditions. After many tests it was found that pollen could be preserved in an active condition for ten days by keeping it in a desiccator containing 50 per cent. sulphuric acid. The types selected so far for improvement are (1) the King or Malayan, dwarf, which is already practically a pure line, (2) the large Rotuman coconut, also practically a pure line, and (3) a reciprocal cross between a King and a native dwarf or Niu leka. Sufficient seed has now been obtained for three isolation



nurseries of two acres, one acre and one-third acre respectively.

In parts of the Colony, the sun-curing of copra is hazardous on account of rains. The large planter meets the situation with a modern drying plant, but for the natives and the small planter there is no suitable dryer available and there is consequently a considerable loss of copra through insufficient drying. Following some work done by the Department of Agriculture in the Philippine Islands, tests have been made with a view to determining whether a combination of sun-drying and sulphuring would be of value. It has been found that if green copra is subjected for four to six hours to the fumes of sulphur dioxide in a reasonably gas-tight chamber, and then spread out on the usual vatas for sun-drying, it resists the spoiling effect of rains for a number of days. The Government Chemist who has carried out the experiments concludes that sulphuring of copra enables a first grade copra to be made on open or running vatas even when heavy rain falls. It is too early to say what practical value these results may have.

When copra contains more than 5 per cent. of moisture it is subject to attack by several species of mould and by insects and in consequence to loss of oil content and to loss of good colour. Experiments are being conducted by the Government Mycologist and by the Government Chemist to show a little more clearly the conditions under which such losses occur.

**Gold Coast.**—According to Mr. C. H. Knowles, Director of Agriculture, the coconut palm is a crop of fair potential importance in the Gold Coast. Trials are being made with its cultivation on a fairly large scale (Western Province 295 acres, Central Province 296 acres, Eastern Province 150 acres), the plantations being set out by the Department of Agriculture. These plantations began to come into bearing during 1927 and yields were obtained of 300 nuts per acre. Information of this kind is urgently necessary, notably with reference to annual fluctuations of yields, and these fields are invaluable in this respect.

A careful analysis was made during the year of the yields of ten plots of a Ceylon variety and ten plots of a local variety of coconuts on one of the Experiment Stations. The figures range over a period of eight years of full bearing for each plot, the area under trial totalling 13 acres, and the yields varying from 228 to 2,095 nuts per acre in the case of the various plots. The individual yield of every palm (673 palms) has been recorded for

eight years and the highest yielding palms have been marked as parents for breeding high yielding strains.

A full analysis of the figures of individual yields, plot yields, acre yields, and of the variations and errors between palms and between plots has been carried out, and is being published in the form of a mathematical paper in the *Year-book* of the Department for 1927.

During the year, model copra dryers have been planned and one has been erected in the Western Province. Moisture and other factors affecting the quality of the copra are being investigated, but results are not yet complete.

A review of the common coconut pests occurring in the Colony has been made, and will be completed during 1928.

**Seychelles.**—Mr. P. R. Dupont, Director of Agriculture, reports that the coconut crop of the Colony has been much handicapped for several years by severe infestation of scale insects, especially *Pinnaspis buxi*, which have spread from wild pandanus trees. It is interesting to note, however, that these insects are now kept under control by an entomogenous fungus, which, according to Dr. Ashby, is an undescribed species of *Kusanoa* and similar to a fungus which hitherto has been recorded only from Japan.

#### Ground-nuts

**Sierra Leone.**—The yields from the plots devoted to manurial trials on ground-nuts at the Njala Experimental Farm (see this BULLETIN, 1927, 25, 296) were as follows :

Manure.	Section No.	Yield per one-tenth acre.	
		Bushels.	lb.
NPK and Lime . . . .	15	4½	94
	17	5	114
NPK . . . . .	1	4	71
	8	5½	113
NP and Lime . . . . .	2	4½	98
	9	5½	121
NP . . . . .	11	4½	77
	18	5½	111
NK and Lime . . . . .	4	5	105
	6	3½	78
NK . . . . .	13	4½	86
	20	4½	92
PK and Lime . . . . .	12	5	108
	19	5½	113
PK . . . . .	3	5½	115
	10	5	102
Control with Lime . . . .	7	5½	110
	14	5	111
Control (no manure) . . .	5	3½	73
	16	3½	76

**Uganda.**—Manuring trials to determine the effect of liming on the yield of ground-nuts were conducted at the Serere Experimental Farm during 1927. Two sets of experiments were carried out, in one case the ground-nuts followed grass lea, and in the other a grain crop. A local variety was sown on April 9 on quarter-acre plots in rows at the rate of 30 lb. per acre, and harvested on August 10. Lime was applied at the rate of 2,000 lb. per acre. The yields of unshelled nuts were as follows :

	Yield per acre.	
	After Grass Lea. lb.	After Grain Crop. lb.
Limed plot . . . .	816	528
Unlimed plot. . . .	400	520

An area of about half an acre was sown on land (after grass lea) adjoining the above plots. Instead of sowing in rows, however, the seed was broadcasted native fashion at the rate of 100 lb. per acre. Some interesting observations were made during the period of growth in reference to the incidence of Rosette disease, and it was noticed that in the broadcasted plot, with close spacing, the crop was comparatively free from the disease, whereas on the plots sown in rows, with wider spacing, the crop did not cover the ground so quickly and the disease was prevalent on all the plots. The application of lime had but a limited effect on the disease, but a heavier application would probably have given more definite results. The yield from the broadcasted plot was at the rate of 960 lb. per acre. The native peasants' contention that close spacing is necessary appears to be a sound one, but their contention that a successful crop can only be obtained from newly-broken land requires further elucidation.

### *Linseed*

**Iraq.**—Varietal tests of linseed have been carried out by the Department of Agriculture for some years. At present the varieties Pusa 46 and Pusa 121 appear to be the most suitable. These varieties yield under local conditions a good plump seed with an oil content of 41–42 per cent. Breeding work is in progress.

Experimental results indicate optimum date of sowing as mid-October to mid-November, and optimum seed-rate as 30 lb. per acre.

### *Oil Palm*

**Federated Malay States.**—The results of work on the oil palm conducted by the Department of Agriculture so far obtained were published in "The Oil Palm in Malaya,"

*Malayan Agricultural Journal* (vol. xv, Nos. 9 and 10, October and November 1927).

The following work is now in progress :

- (i) Experiments to determine the effect of cover crops on yield.
- (ii) Experiments to determine the effect of inter-crops on yield, *Malayan Agricultural Journal* (vol. xv, p. 104).
- (iii) Trials on oil palm interplanted with rubber, each 55 plants per acre.
- (iv) Records of yields and growth of palms on hill land, (a) silt-pitted, (b) terraced.
- (v) Pruning experiments, removing 1, 2 and 3 leaves a month, with controls.
- (vi) Pollination experiments, (a) in an avenue and (b) in a 20-acre field.
- (vii) Investigations of fruiting characters.
- (viii) Determinations of the oil content of fruit in different stages of ripeness.

A collection of numerous varieties of the oil palm from various sources has been made for selection and breeding experiments. These have shown fair germination. At present twenty-nine varieties have been planted in the field, and stocks of many more are in the nursery but are not yet old enough to be transplanted.

Analyses of samples of leaves, leaf-stalks and male flowers have been made for the purpose of determining the quantities of potash, phosphates and nitrogen required by oil palms growing under local plantation conditions. Similar analyses of fruits and fruit-stalks are soon to be commenced.

The efficiency of the oil extraction processes used on estates has been studied, and the results so far collected have been published in the *Malayan Agricultural Journal*, vol. xv.

**Gold Coast.**—Mr. C. M. Knowles, Director of Agriculture, reports that work on Experiment Stations in the Gold Coast was limited to tests aimed at accelerating the germination of the seed. Four methods were tried : (1) untreated seed sown in open beds, (2) untreated seed sown under glass in beds, (3) seed warmed in water to 45° C. once a day for eight days and planted in open beds, (4) seed treated as in (3) but sown under glass. Warming in water in general gave more rapid germination than was obtained by no treatment, but sowing under glass so far appears to be the best method.

Determinations of yields of local oil palm groves continued to be made on a large scale on three blocks in the Central Province, Eastern Province and Western Province (15 acres, 15 acres and 100 acres respectively). In each case the untreated grove was compared with the cleaned area. Owing to the large initial errors in these trials it is unwise to attribute the differences found to the particular method of treatment, although the mere ascertaining of yields is a valuable experimental contribution to knowledge of this plant. Calculation of the errors of these trials is being made and will be published when complete. In general, local yields appear to be considerably below those obtained from plantations in the East Indies and range from 20 to 250 lb. of pericarp oil per acre.

The relationship between distribution of rainfall and distribution of crop is being determined, but records are not yet complete.

Information concerning the life history and distribution of stem rot (*Thielaviopsis paradoxa*) and collar rot (*Ganoderma lucidum*) of oil palms was obtained during the year. Attacks of these fungi on oil palms are not widespread, but the two diseases are not limited to oil palms alone.

**Nigeria.**—Mr. W. E. de B. Diamond, Agricultural Chemist, reports that during the past year a continuation has been made with the development of a cheap form of extraction apparatus for the use of the native oil extractor.

Although the "Cooker Press" process of extraction of palm oil evolved by Barnes (5th Ann. Bull. Agric. Dept., August 1926) gives a fairly good extraction (the efficiency of the process being about 65 per cent.), and the oil obtained is of good quality, it is too expensive to make a wide appeal to the small native oil worker. The cost of the screw press, the most important item, is about £25 landed at Lagos. An attempt has, therefore, been made to evolve a simple lever press, which, while having an efficiency at least as great as the screw press, will be very much cheaper in initial cost.

Such a press has now been evolved and experimental presses are being made to this new design. If this type of press can be produced at a low price it is hoped that it will be extensively used by the native oil extractors, thus raising both the quantity and quality of native produced oil.

**Sierra Leone.**—According to a report furnished by Mr. F. J. Martin, Agricultural Chemist, work has been continued on the oil palm plantations at Njala. The planta-

tions are under the supervision of the Mycologist (Mr. F. C. Deighton) and as described in the previous half-yearly report (this BULLETIN, 1927, 25, 299) the yield of each tree is recorded separately. The 1927 harvest of the Nigerian oil palm plantation was very promising, the average yield per acre for the whole plantation being 23 cwts. per acre of clean fruit. Analyses of the fruits in the laboratory showed that the proportion of oil present varied from 20 to 45 per cent., the higher proportions being found in the thin-shelled varieties. Taking the average oil content as 30 per cent. (an estimate rather on the low side) it will be seen that the yield of pericarp oil for this plantation, in its seventh year, is 774 lb. per acre, a yield which compares very favourably with the average of those obtained in Sumatra for plantations of the same age.

No manuring or artificial pollination was practised and the soil on which the plantation stands is a lateritic gravel. Individual trees give big yields of fruit of high quality and great promise. These trees will be used as parent plants for breeding purposes.

### Sesame

**Uganda.**—At the Serere Experimental Farm during 1927 seventeen different types of sesame (simsim), including individual selections from local native crops, with a number of imported types for comparison, were grown on plots of one-tenth acre, each divided by belts of pigeon pea (*Cajanus indicus*). The calculated yields per acre were as follows :

Variety.	Yield per acre. lb.	Variety.	Yield per acre. lb.
No. 1. Local type . . .	350	No. 10. Local type . . .	600
" 2. " " . . .	600	" 11. " " . . .	500
" 3. " " . . .	250	" 12. Gulu type (Ladongo, big pod)	200
" 4. " " . . .	800	" 13. " " (Latino, small pod)	100
" 5. " " . . .	350	" 14. " " (Gure) . . .	600
" 6. " " . . .	250	" 15. Atura type . . .	350
" 7. " " . . .	350	" 16. Bukumbi . . .	400
" 8. " " . . .	100		
" 9. " " . . .	600		

On the Increase Plots at the Farm, four types of sesame selected in 1925 were sown on April 7 on quarter-acre plots. The yields were as follows :

No.	Yield per acre. lb.	Date of reaping.
No. 1 . . . . .	456	21.7.27
" 2 . . . . .	240	8.7.27
" 3 . . . . .	188	28.7.27
" 4 . . . . .	268	29.7.27

All the plots were attacked by a species of gall midge (*Cecidomyiidae*) on the pods which reduced the yield considerably.

### Soy Bean

**Nyasaland.**—Variety trials with soy beans carried out by the Agricultural Chemist gave the following results :

Variety.	Yield per acre. lb.	Time in reaching maturity.	
		Nyasaland. Days.	America. Days.
O-too-tan . . . .	1,010	106	—
Biloxi . . . . .	825	109	160
Tokio . . . . .	581	101	—
Goshen Prolific . . . .	310	99	145
Tarheel . . . . .	237	78	140
Hayto . . . . .	226	92	135
Laredo . . . . .	99	114	145
Chiquita . . . . .	177	111	135

### ESSENTIAL OILS

#### Patchouli

**Seychelles.**—In a communication to the Imperial Institute, Mr. P. R. Dupont, Director of Agriculture, states that the planting of patchouli is now being encouraged in this Colony. The plant does well under the shade of coconuts and responds to heavy manuring, which at the same time is beneficial to the palms. It has not been found necessary to take much trouble in drying and fermenting the leaves, which are first sun-dried without ill effects, and then dried in the shade.

### FIBRES

#### Cotton

**Fiji.**—The Government Entomologist, Mr. Simmonds, has recently completed experiments on the cause of lint stains of the Sea Island variety of cotton. There are two types of stain, one of which is reddish-brown and the other pale yellow. The former was produced freely in breeding cages by *Tectocoris lineola* that had not had access to diseased plants and appears to be caused mechanically by the adult puncturing the seed. The pale yellow type of stain, which is far more abundant, does not start from a definite point as does the reddish type, but is generally diffused over the affected section of the boll ; it appears to be caused by an organism that is disseminated by *Dysdercus insularis*. In experiments the stain did not result from the punctures of cage-bred fourth and fifth stage nymphs or from adults that had been bred in captivity.

Sea Island cotton has been grown exclusively in Fiji

during the last few years, but as the demand is erratic and small, other varieties are being tested at the Sigatoka Cotton Experimental Station. Mr. Anson is in charge of this work, and has recently had Meade, Sakel, Pima, a hybrid and some kidney cottons under trial. The most promising variety so far is a New Guinea kidney cotton, collected and sent for trial by Colonel Evans. The lint would fetch a lower price than that of Sea Island, but it is a heavy yielding variety and the operations of picking and cleaning seed-cotton would be less expensive. Further trials on a more extensive scale are being made.

**Gold Coast.**—Mr. C. H. Knowles, Director of Agriculture, reports that extended trial is being made in the Gold Coast to determine whether cotton, which has always been cultivated in many parts of the country for local use, can be raised to an export industry. The Northern Territories and the mandated area of Togoland are the areas where the industry seems most likely to succeed, and in these areas seed has been distributed and ginning facilities are provided. Provision has been made for determining the yields of various strains of cotton in these areas and the necessity for obtaining a strain more adapted to the local conditions has not been overlooked.

An investigation of the attacks of stainers and certain other pests has been made, the results being published as *Bulletin No. 12* of the Department.

**Iraq.**—Varietal tests carried out by the Department of Agriculture with imported varieties from all cotton-growing countries have led to the selection of "Webber" type American cotton as being most suitable for Iraq.

Breeding of new varieties by hybridisation and improvement of existing varieties by selection are constantly being carried out. Selected strains are propagated for distribution. An investigation into the cause of low ginning percentage of cotton grown in Iraq is in hand. Other investigations which are in progress, but which have as yet given no definite results, are concerned with (1) differential irrigation and (2) bud and boll shedding.

As regards the cultivation of cotton in Iraq, the Department make the following recommendations.

Under average conditions cotton should be sown on ridges rather than on the flat, the ridges to be 3 ft. apart and seed sown at 15 in. intervals on the southern side of the ridge. Watering should be discontinued as from the end of the first week in October. The optimum sowing season for Central Iraq is from mid-March to mid-April;



crops sown as late as June are definitely unremunerative. Thinning to two plants per seed-hole should be carried out when floral buds just begin to appear.

**Leeward Islands.**—*Antigua.*—Mr. A. Gallwey, Agricultural Superintendent, Antigua, reports that in consequence of the increased interest in the growing of this crop in the island, it was decided during the half-year ending June 1927 to establish breeding plots at the Experiment Station of each of the three types of Sea Island cotton grown, viz. Antigua, Montserrat and Barbados. Plots of each of these types were sown and plant-breeding work carried out with a view to the elimination of inferior types; spinning and field characters being joint points of consideration.

*Montserrat.*—Cotton-breeding work constitutes the most important line of activity at the Experiment Station, Montserrat, according to a report by Mr. C. A. Gomez, the Curator, on the work carried out during the first half-year, 1927. The sowing of the various cotton plots was effected on March 1, and the entire cotton work progressed most successfully this season as a result of the propitious climatic conditions experienced.

The cotton-breeding plots were increased and a greater supply of pure Heaton cotton seed will be available for distribution to planters in the coming season. The self-fertilisation of cotton flowers in the breeding plots, the various counts for flowers, bolls, loculi value and the analysis of seed-cotton for lint factors formed daily work for the station staff during the period under review. In general the cotton-breeding work was again chiefly concerned with comparative tests of re-selections from the strain of cotton designated H. 23-2-13, isolated in 1918.

In a further report for the half-year ended December 1927, Mr. Gomez mentions that the cotton-breeding plots continued to receive the attention of the entire staff of the Agricultural Department, and states that the ample supply of pedigree Heaton seed supplied from these plots to planters was directly responsible for the improved condition of the quality and the high output of the Montserrat cotton crop in 1927.

**Nigeria.**—Surveys of the factors inhibiting the development of various species of cotton are still in progress at Ilorin and Ibadan. The Ilorin survey is being carried out by the Senior Entomologist, Mr. F. D. Golding, who also initiated the survey at Ibadan in August; the latter survey was controlled by the Entomologist, Mr. O. B.

Lean, during October and November, and is being concluded by African assistants under the supervision of Mr. Golding.

1. *Cotton Investigations at Ilorin.*—Before summarising the results to date, Mr. Golding points out that he would like to emphasise the fact that the figures given in this report may differ considerably from the final figures for the entire season ending in March.

The following native cottons are being studied at Ilorin: Mr. C. J. Lewin's improved Ishan-Strains A, B and E, Ilorin and Kabba. Contiguous plots—each one-tenth of an acre in area—of Ishan A and B and Ilorin, were selected in both blocks G and H (cotton grown alone), and also in Block A (cotton through yams). One-tenth acre of Kabba through yams in Block E was selected and certain observations were made on a similar area of Ishan E, in Blocks G and A. The Kabba was sown on June 1, and the remaining varieties in the first week of July.

The rainfall for 1927 closely approximated to the average of the preceding 22 years (50.97 in. as compared with 50.43), but the distribution was typical. The September rainfall was 3.18 in. below the average, and the October figure was 3.61 in. above.

The following is a summary of the results obtained up to December 31, 1927:

(a) *Bud-shedding.*—The proportion of sheds damaged by bollworms was from  $2\frac{1}{2}$  to 6 times greater in the plots through yams (Block A) than in the plots of cotton grown alone in Block G, while the corresponding figures for sheds bearing bacterial lesions were from  $2\frac{1}{2}$  to 4 times less.

(b) *Flowering.*—Ishan A and B are three weeks later in their flowering than Ishan E and Ilorin, while cotton through yams is from three to four weeks later than cotton grown alone. It will be seen that Ishan A and B through yams are about seven weeks later than Ilorin grown alone—a fact that may be of great importance in insect control. Very few flowers have been produced on Kabba to date.

(c) *Boll-shedding.*—Very similar to bud-shedding, bollworms being prevalent in cotton through yams, and bacteria in cotton grown alone. The differences in the proportions of sheds bearing lesions of various types on Ilorin and Ishan A and B were small in each block, except for an abnormally high percentage of *Alternaria* sheds on Ilorin grown alone.

(d) *Harvested Bolls.*—Harvesting is still in its early stages; at present bollworms and bacteria have caused the greatest amount of damage to seed-cotton in all plots.

At the time this report was written it seemed probable that Ilorin would give greater yields than any of the improved strains of Ishan, but that the proportion of clean seed-cotton on the latter would be markedly greater. Ishan A is giving a slightly greater yield than B.

(e) *Insect Incidence*.—Cotton stainers were unusually scarce during the season, whereas bollworms were numerous; bollworm activity was greatest between mid-November and mid-December. Leaf rollers, *Sylepta derogata*, did much damage in the second half of October, but were controlled by parasites in the succeeding month. The larvæ were more numerous on Ishan A and B than on Ilorin. Jassids did much damage to Ishan E and Ilorin in Block G, but Ishan A and B appeared to possess a considerable degree of immunity, probably on account of their pubescent leaves.

(f) *Fungoid Pests*.—Bacterial disease has been extremely prevalent in its various forms, viz. Angular Spot (on leaves), Black-arm, on young bolls (causing abscission) and on seed-cotton. Cotton through yams was freer from Angular Spot than cotton grown alone; it has already been stated that both bud and boll-sheds in the former had a smaller proportion of bacterial lesions. *Alternaria* was prevalent only on Ilorin in Block G during October. Anthracnose has not been observed.

(g) *Leaf Curl*.—This virus disease has done much damage to Ishan E and Ilorin, but both Ishan A and B showed a high degree of immunity. On December 31, the following percentages of plants were found to be infected: Ishan A 11.6, Ishan B 16.7, Ilorin 40.2, and Ishan E 78.2. Mr. Golding mentions that he is indebted to the chief Botanist, Mr. C. J. Lewin, for these data.

2. *Cotton Investigations at Ibadan*.—Cotton stainers and bollworms have not been numerous. The principal pests have been leaf curl and the capsid bugs (*Helopeltis* spp.).

Possibly as a result of the presence of an abnormal number of the vectors of leaf curl Ishan A and B have not manifested their usual qualities of resistance to this disease. Flowering has been sparse and a poor crop is anticipated.

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Mr. T. Laycock, the Senior Mycologist, reports that seed disinfection of Ishan cotton was carried out, using the modified method of delinting the cotton-seed as described by Sherbakoff in *Phytopathology*, vol. 17, No. 3. This method, which consisted of applying the minimum amount of sulphuric acid to effect disinfection, is such that it is possible to treat three times the amount of seed as is

treated by using the original standard method devised by Duggar. It was found that whereas the treatment did not give complete control of Angular leaf spot, it resulted in a considerable diminution of the disease. Observations at the time of maximum foliage of the cotton plants gave the following results :

		Per cent. of infected plants.
Treated plot		5.9
Untreated plot	Ishan (with Meko) mean of two plots	58.1
"	" Meko (with Ishan)	50.0
"	" Ishan grown alone	23.0

A further experiment on seed disinfection by exposing the cotton-seed to sunlight is now being carried out. Seed was exposed for one, two and three days. In each case samples were placed on sheets of iron, on wood and on earth. Germination tests showed that the treatment affected the viability of the seed adversely. The percentages of seeds germinating are given herewith :

Of seed exposed to sun 1 day	.	.	.	.	.	59
" " " " 2 days	.	.	.	.	.	45
" " " " 3 "	.	.	.	.	.	41
Untreated seed	.	.	.	.	.	70

The average temperatures within the seeds during exposure to the sun were as follows :

On Iron	.	.	.	.	.	60° C.
" Wood	.	.	.	.	.	57° C.
" Earth	.	.	.	.	.	57° C.

All these temperatures are above the thermal death point of *Pseudomonas malvacearum*. To this thermal factor must be added the sterilising effect of the ultra-violet rays of sunlight. Pot experiments are now being carried out to ascertain whether the treatment can control Bacterial disease.

The fungus of Internal Boll Disease, caused by *Nematospora gossypii* Ashby and Nowell, has been isolated from material received from Zaria.

**Nyasaland.**—The following summary of the results of experimental work on cotton in Nyasaland during the half-year ending December 31, 1927, has been furnished by Mr. H. C. Ducker, Cotton Specialist of the Empire Cotton Growing Corporation.<sup>1</sup>

This season's experimental work has been completed and worked up during the past three months. It is a

<sup>1</sup> Detailed reports of the work of the officers of the Empire Cotton Growing Corporation in Nyasaland and other countries of the Empire are published annually in *Reports Received from Experiment Stations*. The latest volume, covering the year ending June 1927, is obtainable from the offices of the Corporation, price 2s. 6d. post free.

matter of satisfaction to note that a number of important results have been obtained.

*Makwapala*.—A newly selected strain of an American variety called "Over the Top" has proved very successful, giving an average yield for the whole station of approximately 1 cwt. of clean white lint per acre, and in the case of one area of five acres in extent nearly 2 cwts. per acre was reached.

A series of spacing experiments using the "Over the Top" strain as seed gave decidedly inconclusive results which were presumably due to the plot layout adopted not being suited to coping with the effects of severe and localised bollworm attack. A repetition of these experiments has been made; the plots were sown in December, in which the use of a modified type of layout is expected to surmount this season's difficulties.

An experiment designed to compare the relative advantages of ridge and flat planting indicated that the latter was preferable, both from the point of view of yield and of quality of lint obtained.

A variety trial using "Over the Top" and ordinary Nyasaland Upland gave an inconclusive numerical result. There were however indications, drawn both from this experiment and from observations made on bulk sowings of "Over the Top" on the station and elsewhere, that the "Over the Top" is the better variety for the conditions which Makwapala represents.

A very considerable quantity of pure-line seed was obtained from selections, which had been made from the "Over the Top," and has been sown in bulk increase plots. From these it is hoped to obtain this coming season a new and improved strain of the "Over the Top" wherewith to replace the present mixed stock. It is satisfactory to note that good stands of these new strains have been obtained, so that given a good season considerable amounts of seed will be available.

*Port Herald*.—It was discovered that the "Over the Top" strain, evolved to meet up-country conditions, was by no means the best variety at this station. Fortunately a variety called "Foster-Whitehall," a failure at Makwapala, proved very well suited to this season's conditions at Port Herald, giving nearly 280 lb. of clean white lint per acre. The season was by no means abnormal, and it has therefore been decided to concentrate on the "Foster-Whitehall" as the Lower Shire Cotton for the coming season at least.

A series of spacing experiments similar to that used at Makwapala gave somewhat contradictory results,

but it was of interest to note that the highest yield was given by the spacing most like that favoured by native growers, while the second highest increase was given by the standard bulk spacing in use at the two stations. The experiments are to be repeated.

A time-of-planting experiment gave an interesting series of results, which showed that under this season's conditions there was no advantage in planting cotton at Port Herald before February 15. This result was shown by records kept to be entirely due to the later planted cottons missing the worst of the insect attack. As foreshadowed in the 1926 report the insect pests appeared to have fairly definite seasonal distributions, so that other things being equal cotton could be planted at such a time that the majority of the pests were "dodged."

A variety trial, similar to that sown at Makwapala, gave results showing "Over the Top" to be definitely inferior to the ordinary Nyasaland in yield. This result was confirmed by observations on bulk sowings on the station and elsewhere on the Lower Shire. The trial is, however, to be repeated this coming season to provide confirmation of the results obtained. In addition a trial of the new "Foster-Whitehall" strain is to be made, using the same Nyasaland Upland strain for comparison. It may be mentioned that the lint of the "Foster-Whitehall" is decidedly superior both to the "Over the Top" and to the Nyasaland Upland lint as regards staple length. Samples have been sent to England for spinning trials.

Pure-line work using "Over the Top" and "Foster-Whitehall" strains is being carried on at Port Herald as at Makwapala, but no lines have so far been selected for increase plots.

A test distribution of "Foster-Whitehall" has been arranged for this coming season.

*Insect Pests.*—Mr. C. B. R. King, Cotton Entomologist, reports that during the half-year ending December 1927, work was carried out on a plot of five acres in the Liwonde district. The main problem tackled was the prevention of the moths of the red (Sudan) bollworm from laying eggs, by trapping them. The first crop was picked by June. A second crop matured in September and October after five months of dry weather (May onwards). Neither red nor American bollworms were found in this crop; but this is to be expected in this locality, which enjoys a long spell of fine, dry weather after the cessation of the rainy season in March or April. On the other hand, a few spiny bollworms were found, but not in sufficient numbers to cause much damage. This crop, however, was much

less than anticipated, partly due to the action of baboons, monkeys and rats, and partly to stainers, which multiplied exceedingly, in spite of large numbers caught in traps. Stained cotton formed about 30 per cent. of the crop and some 10 per cent. of the bolls in the field were destroyed by internal boll-rot. The final yield for the year worked out at 217 lb. of lint per acre. The average yield on the estate where the experiments are being carried out is 77 lb. of lint per acre for the years 1921-25 inclusive, the maximum during this period being 100 lb. in 1922, an exceptionally dry year. In 1926, the first year of experimental moth-catching, a yield of 90 lb. was obtained, but the cotton was pulled up before most of the second crop was picked.

A fact of some interest and importance came to light during the first part of the season concerning the immigration of moths into the cotton field. Where there is a focus external to a field of cotton, such as a plot of ground under cotton attacked by bollworm the previous year, an influx of moths only takes place when there is a wind after sunset blowing towards the focus. If there is no wind, or if it blows in a direction in which there is no focus, there is no such flight.

**Sierra Leone.**—In addition to the varieties of cotton mentioned in the last half-yearly report (see this BULLETIN, 1927, 25, 298), the following are also being tried at the Njala Experimental Station: Acala, Nunn's 37 and three strains of Punjab American. Figures of yield are not yet available, but Delta Webber and Cambodia have given the most promising-looking stands of imported cottons.

**Tanganyika.**—Experiments have been conducted by the District Agricultural Officer, Morogoro, to ascertain the optimum planting distances for cotton. Seed of the Uganda Upland variety was planted on February 26, 1927, on land previously cropped with cowpeas. The results of the trials are shown in the following table:

Distance.	Plants per hill.	Calculated yield of seed- cotton per acre. <i>Kilos.</i>
3 ft. × 6 in.	1	300·5
3 ft. × 9 in.	1	206·5
3 ft. × 12 in.	1	229·8
3 ft. × 18 in.	2	226·5
3 ft. × 24 in.	2	176·5
3 ft. × 30 in.	2	143·0
3 ft. × 6 in.	1	173·5
3 ft. × 9 in.	1	266·5
3 ft. × 12 in.	1	216·0
3 ft. × 18 in.	2	241·5
3 ft. × 24 in.	2	143·5
3 ft. × 30 in.	2	160·0

*Flax*

**Cyprus.**—Experiments have been made by the Department of Agriculture to determine the fuel value of briquettes made from flax shieves and scutching waste. Briquettes prepared with the addition of 5 per cent. of pitch as a binder were found to have a fuel value of 4,918 calories, which is low compared with coal, which averages about 7,500 calories.

**Iraq.**—During the period of high prices for flax, experiments were conducted with this crop by the Department of Agriculture. It was shown that good flax can be produced, but at present prices the margin of profit is narrow. During the period of high prices a certain amount of flax was grown by cultivators, but in the absence of a commercial flax mill, they were unable to dispose of their crop. Interest in the crop has now waned and experimental work has been dropped.

*Mauritius Hemp*

**Federated Malay States.**—Records are being collected by the Department of Agriculture on :

- (i) Crop yields.
- (ii) Percentage of fibre in the leaves.
- (iii) Tensile strength of fibre.

A crop of leaves is being harvested and decorticated. The fibre is being baled as it becomes available to form a shipment that will be sent to London next year for a report on quality and for sale.

*Piassava*

**Sierra Leone.**—Investigations have been carried out by Mr. F. J. Martin, Agricultural Chemist, on the native methods of retting piassava. Local swamps have been visited and the industry and material examined *in situ*. As a result of these visits and laboratory retting trials, recommendations have been made for the preparation and marketing of this fibre. A pamphlet on "The Piassava Industry of Sierra Leone" has been prepared and submitted for publication. This pamphlet describes the two types of palms used, the native methods employed, and the way the industry is handled by exporters. Photographs of each stage of the industry are given, and recommendations made to ensure the production of good, clean, dry fibre.



*Silk*

**Cyprus.**—Two samples of silk were sent by the Agricultural Department to the Bureau de Titrage of the "Condition Publique des Soies, Laines, Cotons et autres textiles," of the Chamber of Commerce, Lyon, for examination and report. Silk reeled from cocoons produced from silkworm eggs raised in the Island showed an elasticity of 22·8 per cent., while the elasticity of silk reeled from cocoons produced from silkworm eggs imported from France was only 20 per cent., but as a titre the former is not so regular and shows for the milieu 15, while the titre of the latter is 12 only.

**Iraq.**—An attempt has been made by the Department of Agriculture to revive the old silk industry of the country. Imported varieties have been and are being tested on the experimental farm, and an attempt to isolate the original "Baghdad White" strain from the existing decayed and diseased local variety is well advanced and promises success.

Feeding tests with different varieties of mulberry have also been started and suitable early leafing varieties are being propagated. The present difficulty is that cocoon production is now sufficient to meet local demand, but is much below what is needed to justify a commercial filature. In conjunction with the Advisory Committee on Silk Production of the Imperial Institute, the Department has sent an experimental consignment of cocoons to the Cyprus filature, with a view to finding out the prospects of success of a cocoon export trade. It is hoped that by this means the industry may find a market for its produce, until such time as this justifies the erection of a filature.

*Sisal Hemp*

**Federated Malay States.**—Work is being carried out on sisal by the Department of Agriculture. Results previously obtained show that under local conditions the leaves yield as much as 4·5 per cent. of fibre of good average quality (see *Malayan Agricultural Journal*, vol. xii, p. 352).

The following work is in progress :

- (i) Observations on the optimum period to allow between cuttings.
- (ii) Experiments on planting distances (two).
- (iii) Comparison between suckers and bulbils as a source of planting material.
- (iv) Investigations on harvesting.

**Gold Coast.**—Investigational work on the yields of sisal per acre, percentage of fibre obtainable, method of preparation and costs of each item of work in field and factory, have been carried out by the Department of Agriculture on an experimental area of 800 acres. The full results are being published shortly as *Bulletin No. 13* of the Department, and will form a valuable contribution to the knowledge of the requirements, treatment and costs of production of this crop, the results being on a large and at the same time exact and reliable scale.

Two complete years of bearing have now been dealt with and information is exact enough to enable the Department to speak with authority about this crop. The further task of devising means whereby the industry will be accepted by local farmers now awaits the Government, since up to the present no plantation other than the Government one has been made.

#### *Wool*

**Iraq.**—In connection with the efforts of the Department of Agriculture to improve the quality of Iraq wool, standard types of local sheep have been collected on the Experimental Farm, and fourteen merino ewes and rams are expected to arrive from Australia shortly. Reports on sheep and Angora goat fleeces received at the Imperial Institute from the Department will be found on p. 140 of this BULLETIN.

#### RUBBER

##### *Hevea*

**Federated Malay States.**—The Acting Secretary for Agriculture reports that the research work of the Department has been transferred to the Rubber Research Institute of Malaya, but certain investigations on latex, commenced in 1923, were continued until unfinished work in progress reached a suitable stage for publication. The last results obtained were recorded in the *Malayan Agricultural Journal*, vol. xv, No. 8. These investigations have shown that the initial changes in the rate of vulcanisation of rubber from preserved latex are not accounted for by the hydrolysis of the proteins in the latex, but that the variation in the rate of vulcanisation is probably associated with changes in its fatty acid constituents.

**Gold Coast.**—According to Mr. C. H. Knowles, Director of Agriculture, labour and economic conditions in the Gold Coast are not in favour of this crop becoming a valuable industry locally, and as a result tapping trials which were

continued for many years at Experiment Stations were discontinued some years ago. High prices in 1927 resulted in resumption of tapping on the two private plantations which exist in the Colony.

The sole problem investigated by the Department was the identification of a disease of a tapping cut which proved to be the " Mouldy Rot " (*Ceratostomella fimbriata* or *Sphaeronema fimbriata*) known in the East, but hitherto unrecorded in the Gold Coast.

### *Jelutong*

**Federated Malay States.**—The investigations which were carried out by the Department of Agriculture on methods of preparation of jelutong (see *Malayan Agricultural Journal*, vol. xv, No. 3) have been followed by a study of the deterioration of commercial jelutong. The results so far obtained have appeared in the *Malayan Agricultural Journal* (vol. xv, No. 10, p. 400).

### TOBACCO

**Leeward Islands.**—*Montserrat.*—Mr. C. A. Gomez, Curator of the Experiment Station, Montserrat, reports that during the first half-year 1927, a small plot of Porto Rico filler tobacco was grown and a sample of the leaf was sent to the Imperial Institute for report.

The results of the examination of the sample showed that the tobacco on the whole had not been properly fermented, and the burning properties were somewhat unsatisfactory. The best leaves, however, were of promising appearance and the quality could possibly have been improved by proper fermentation and adequate maturing.

During the second half-year large scale experiments with tobacco types were planted out and special fertiliser experiments are being conducted in these plots to improve the quality of the locally grown tobacco. A type suitable for the English market is still being aimed at, and interesting results are expected from the crop now under cultivation.

**Nyasaland.**—Mr. A. S. W. Hornby, Agricultural Chemist, reports that during the half-year ending December 1927, variety trials were carried out with the following results :

Variety.	Yield per acre. lb.
Western (Acclimatised) . . . .	835
Wildfire Resistant Orinoco . . . .	540
Melton . . . . .	485
Green Briar Burley . . . . .	640



that such a temperature was not reached below the 6-in. level: the eelworm referred to is *Heterodera radiculicola* Greef. Laboratory experiments showed that solutions of the local fish poisons (*Tephrosia Vogelii* and two kinds of roots) were ineffectual in killing eelworm in the soil. It was found that a 5 per cent. solution of sodium fluoride killed them in a few seconds, but this cannot be watered on to plants. Crop rotation experiments in the control of eelworm and yellow stem-grub (*Dereodus recticollis* Mshl.) have been started in conjunction with the Agricultural Chemist. Wireworms and millipedes have seriously attacked tobacco and a light application of "Cyanogas" was used, but results are not yet to hand.

**Southern Rhodesia.**—Mr. J. I. Roberts, Entomologist on the staff of the Department of Agriculture, has carried out a rough investigation concerning the penetration into the soil of heat produced by the common "open fire" method of sterilising tobacco seedbeds. Dry grass and maize cobs were used for the fire, the heaviest dressing being a thin layer of grass plus ten grain bags of maize cobs over an area of 120 square feet. Owing to lack of suitable apparatus, readings had to be postponed for three hours, when the following temperatures were recorded:

At 3 inches . . . . .	176° F.
" 6 " . . . . .	140° F.
" 9 " . . . . .	112° F.
" 12 " . . . . .	100° F.
" 18 " . . . . .	86° F.
" 24 " . . . . .	80° F.

It is judged from this experiment that a degree of heat lethal to insect life and root gallworm (*Heterodera*) is commonly produced and maintained for a sufficient length of time, to a depth of at least 6 in., but more exact readings would be of interest.

Mr. A. Cuthbertson, Entomologist, has continued experiments with calcium cyanide dust as a soil fumigant in tobacco seedbeds, the beds being trenched to various depths, the dust sprinkled on the exposed surface and immediately covered over. This treatment has not proved effective.

**Uganda.**—The following report relates to tobacco experiments carried out by the Department of Agriculture in Bunyoro up to the end of December 1927.

Harvesting of the tobacco planted at Bulindi on April 21, commenced on July 2, and was completed on the 25th. The "priming" or single leaf method of harvesting

was used throughout. The leaf was of good average size, heavy and oily. The whole of the crop was cured by the open fire method and the average time taken to cure and dry out each picking was thirty days. The cured leaf was of good colour and fair body and texture. From the two acres planted, 1,490 lb. of cured leaf was obtained.

Another sowing was made on July 29. Germination was good and no trouble was experienced in the nurseries. Plants were ready to go out in the field at the end of September. The same ground was used for planting after being well cultivated after the first crop was taken off. Unfavourable weather conditions were experienced throughout October, and a large number of plants failed to become established in the field, and owing to the very dry weather blanks could not be replanted. November also proved a very dry month and growth was very poor, and at the middle of December when the plants commenced to show flower and were topped, the plants were still small. The lower leaves were commencing to ripen at the end of December and it was anticipated that harvesting would commence about the second week in January. Weather conditions have been entirely against this second planting and the crop will be a poor one, but there is no doubt that under normal conditions two crops may be obtained during the year.

An experimental planting of cigarette tobacco (var. Hickory Pryor) has been made on a European plantation near Masindi. Seed was sown on July 15; germination was satisfactory, and the tobacco was ready to plant out at the middle of September. Difficult weather conditions were experienced, however, and the main planting was not done until October 10. In this area better weather conditions were experienced during October and November, and growth was rapid. The plants were topped at the beginning of December, an average of twelve leaves being left on each plant. Harvesting commenced on December 14. The leaves were large and of medium body and weight. The leaf coloured well in the barn, but difficulty had been experienced in obtaining suitable material for the construction of flues, and the material used proved not to be strong enough to withstand the heat at the high temperature required to finish the curing, and consequently operations had to be suspended before the leaf was properly cured. Two further attempts were made, using other material for the flues, but with no better results, and the experiment had finally to be abandoned for this season. This experiment, as far as it could be carried through, showed great promise of success and there is little doubt

that good coloured yellow tobacco can be produced on the lighter soils of Uganda.

## DRUGS

### *Cola*

**Gold Coast.**—This is a crop of considerable importance in the Gold Coast and, according to Mr. C. M. Knowles, Director of Agriculture, practically nothing is known of it by the local Department or by Departments in other tropical countries. A paper is being published in the *Year-book* of the Department for 1927, in which the fact is proved that the ratio of white to pink seeds on the cola tree is a function of age. Frequency curves of a high degree of symmetry result from the plotting of these ratios, showing that the proportion of white seed increases from nil in the first two years of bearing to a maximum of over 70 per cent. in the 6th to 9th years of bearing, and then falls again to nil in subsequent years. Locally the white seed is in such request that over four times as much is paid for it as is obtained for the pink seed.

Individual yield records of a block of 150 trees on one Experiment Station, and 68 trees on another station, were made during 1927 on which will be based trials aimed at the selection of high yielding strains. In addition, by summing up the individual yields it will be possible to arrive at reliable figures of yields per acre of this crop. Results are not yet ready for publication in full.

### *Papaw*

**Leeward Islands.**—The breeding of a type of papaw, showing the very desirable characteristic of producing a heavy yield of dried papain, was continued at the Experiment Station, Montserrat, and seeds of this type have been distributed to planters.

## FORESTRY

### GENERAL

**British Guiana.**—A valuation survey was carried out by the Forestry Department, between August 30 and December 9, on the Barima River, North-West District. Three Assistant Conservators and three Forest Surveyors carried out the work with a party of fifty men. The "Brandis Strip" method of valuation was employed as usual. About 195 square miles were covered by the survey, which ran for about forty miles (as the crow flies) along the banks of the river. Statistics of volumes are in

course of preparation. In the areas lower down river, work was much hindered by swamp. Forty-seven Mora trees and forty-nine Crabwood trees were felled and measured. This allowed of volume tables being further revised.

**British Honduras.**—Silvicultural research on the regeneration of mahogany (*Swietenia macrophylla* King) and pine (*Pinus caribæa* Mor.) continues. Successful results have been attained in natural regeneration of both species, and experiments in the growing of mahogany on the "taungya" system show distinct promise.

**Cyprus.**—During the last five years the counting of the number of seeds per lb. in certain indigenous and introduced species of trees has been undertaken with the following results :

Species.	Number of seeds per lb.	Number of tests.
Aleppo pine ( <i>Pinus halepensis</i> ) . . .	6,788-12,960	3
Cypress ( <i>Cupressus sempervirens</i> ) . . .	42,570-100,800	4
Troodos juniper ( <i>Juniperus foetidissima</i> ) . . .	1,612-1,884	3
Olive ( <i>Olea europæa</i> ) . . . . .	1,509-1,808	3
Carob ( <i>Ceratonia Siliqua</i> ) . . . . .	2,384-2,592	3
Oriental plane ( <i>Platanus orientalis</i> ) . . .	60,346-60,641	3
Stone pine ( <i>Pinus Pineæ</i> ) . . . . .	662-1,192	4
Wattle ( <i>Acacia cyanophylla</i> ) . . . . .	24,422-46,080	4
Persian lilac ( <i>Melia Azedarach</i> ) . . . .	820-1,751	3

**Iraq.**—The Department of Agriculture has no Forestry branch, but large numbers of trees have been introduced from abroad with a view to testing their suitability for Iraq. The most valuable varieties for Southern and Central Iraq, in addition to the mulberries, poplars and willows already grown, appear to be Shisham (*Dalbergia Sissoo*) and various eucalypts (especially *E. rostrata*). Certain fairly large areas in the North, particularly in Kurdistan, are probably suitable for afforestation.

## TIMBERS

**British Guiana.**—No research was completed during the last half of 1927, but experiments in seasoning Crabwood and Purpleheart are being carried out by the Forestry Department. The reputation of the former for splitting and twisting would seem to be rather exaggerated. Undressed boards which were split when stacked showed an average increase of about  $4\frac{1}{2}$  in. in length of split, while dressed boards showed about  $2\frac{1}{2}$  in. increase in six months. In the same time undressed boards which were stacked "off the saw" showed 1.65 per cent. shrinkage in breadth, and similar dressed boards gave 1.93 per cent. shrinkage.



**British Honduras.**—Identification work continues and over 250 species have been listed. The local Commercial Rosewood has been determined as a new species, *Dalbergia Stevensonii* Standl.

## GUMS AND RESINS

### Chicle

**British Honduras.**—The structure and functions of the latex cells of *Achras Sapota* L. are under investigation by an officer of the Tropical Plant Research Foundation, in connection with the experimental work on the growing of this species for the production of chicle, a basic constituent in the manufacture of chewing gum.

## MISCELLANEOUS VEGETABLE PRODUCTS

### ALCOHOL

**Federated Malay States.**—The amylo-bacter process for the production of "samsu" from rice is being investigated by the Department of Agriculture, with a view to introducing improvements in the local Chinese distilleries, where there are at present much loss of efficiency and corresponding waste of an important food.

Experiments have also been carried out on the treatment by fermentation of pineapple refuse from local canning factories, with the object of utilising the waste juice for the production of a potable alcoholic liquor. It has been found that both toddy-yeast and the yeast in Chinese rice-cake are suitable for the fermentation of the juice. It is also possible to concentrate the juice to syrup for use in canning, or as a beverage. The solid refuse after separating the juice can be converted into an innocuous material which would appear to be useful as a manure or as an ingredient in cattle foods. These results are about to be published in the *Malayan Agricultural Journal*.

Tapping records have been collected on the nipah palm estates now coming into bearing. The results published in the *Malayan Agricultural Journal*, vol. xv, No. 12, indicate that a yield of 1,300 to 1,400 gallons of alcohol per acre per annum may reasonably be expected.

### TUBA ROOT (*DERRIS* spp.)

**Federated Malay States.**—Three types of tuba root are under trial at the Government Experimental Plantation, Serdang, namely, *Derris elliptica* (Malay "Tuba Merah"), *Derris malaccensis* (Malay "Tuba Puteh"), and *Derris malaccensis* var. (an erect form from Sarawak).

Work is in progress to determine the relative value of these different types in the preparation of an insecticide. For a study of the value of tuba root as an insecticide, it appears to be desirable to obtain more information concerning the value in this respect of aqueous extracts of the kind in common use locally. A comparison is being made of the results obtained at Rothamsted by the use of dry partially aged roots with the results obtained here by the use of fresh aqueous extracts from roots of known history.

## MISCELLANEOUS ANIMAL PRODUCTS

### SPONGES

**British Honduras.**—Investigation of the possibilities of sponge-growing has been continued under the guidance of an expert deputed by the Colonial Research Committee, and the Government has purchased a large island enclosing lagoon waters suitable for the establishment of this industry.

## MINERAL RESOURCES

### CYPRUS

The Director of the Imperial Institute is indebted to the Colonial Secretary of Cyprus for the following progress report on the mining industry of that Island :

Work has been carried on without intermission on the larger mines, and both at Skouriotissa and Amiandos the yearly productions of pyrites and asbestos show large increases on the tonnages of former years.

Prospecting work has been conducted at numerous localities without the discovery of any fresh mineral resources. This is not surprising, as in the majority of cases holders of prospecting permits are working very superficially and find themselves unable to proceed to any depth.

A keener interest from the outside mining world is apparent by the visit of expert engineers who have advised large and influential mining houses to apply for prospecting rights in the Island.

**Pyrites.**—For the six months ending December 31, 1927, 112,278 tons of pyrites were produced, being an increase of 31,873 tons over the corresponding period of 1926. The total production for the year ending December 31, 1927, was 200,176, an increase of 34,663 tons over the year 1926.

In August 1927 the Cyprus Mines Corporation started the sinking of two shafts and the driving of an adit to open

up the Mavrovouni ore-body. It is expected that it will be at least three years before this area is ready to produce. In the meantime, further bore-holes are being put down to explore the extent and dimensions of the ore-body, and the bores put down during the six months under review have given very satisfactory results. The Corporation have developed their ventilating scheme at the main mine at Skouriotissa and conditions underground are very much better than a year ago.

As a result of the visit of several mining engineers and geologists to the Island earlier in the year, the Pyrites Company, Ltd., of London, have applied for and have been granted a fairly large area and have secured the transfer of another prospecting area. The Company, it is understood, intend starting a systematic and intensive prospecting campaign, and as a preliminary are sending out their Mining Engineer and Geologist early in 1928 to advise on the future programme.

*Chrome Ore.*—The production of chrome ore has been disappointing, only 500 tons having been extracted and shipped during the six months under review.

The present position with regard to chrome-ore mining in the Island is difficult and unsatisfactory. With one exception, the holders of mining leases and permits are not technical, and mining is conducted on very haphazard lines, with little consideration for the grade and mechanical condition of the ore.

Chrome ore exists and has been opened up at several places in the Island, but very little has been done to examine and gauge the extent or grade of the deposits.

With a view to developing the possible resources of this mineral and, if results warrant it, to creating a more regular industry, it is proposed to negotiate the amalgamation of all areas, which would be worked under a common company, and not as independent units as is the case at present.

*Copper Precipitate.*—Production of this is on a very small scale, amounting to some three tons a month, and it does not appear that there is any immediate likelihood of this amount being appreciably increased.

*Manganese Ore.*—About 10 tons of manganese ore (pyrolusite) were extracted, hand-sorted and exported from the Island, more in the nature of a trial shipment. The buyer's analyses were not encouraging, and it would appear that the manganese indications have not been found on a scale promising commercial possibilities. They prove, however, that manganese occurs in the Island, a fact that should not be overlooked by prospectors.

*Gypsum.*—The export of crude gypsum amounted to 560 tons, and of calcined gypsum to 7,000 tons for the six months. These figures are a slight increase over those for the corresponding period of 1926. It is impossible to give exact figures of the total extraction of gypsum as it is mined all over the Island and used for domestic purposes.

*Asbestos.*—During the six months under review, the Cyprus Asbestos Co. exported 9,274 tons of asbestos, this being an increase of 4,590 tons over the corresponding period of 1926. The total production of the Company for the year amounted to 11,200 tons, an increase of 4,032 tons over 1926. From other sources the export of asbestos amounted to 181 tons for the last six months of the year.

The Cyprus Asbestos Company are now preparing for a more intensive mining programme in 1928, when a production of 15,000 tons of asbestos is being aimed at. Experiments are being conducted with a view to the utilisation of mill waste, and it is understood that the satisfactory results so far obtained may lead to the erection of a briquetting plant.

*Terra Umbra.*—During the last six months of the year, 3,319 tons of "terra umbra" have been exported from the Island, bringing the total exported for the year to 5,567 tons, being an increase of 200 tons over the previous year. Practically the whole of the export tonnage is derived from one district (Larnaca). "Terra umbra" of equally good quality occurs in other districts, and endeavours are being made to create a much wider market for the mineral.

*Terre Verte.*—Sixteen tons of "terre verte" have been exported during the six months under review. No definite deposit is developed and there is no organised mining of the substance.

It is considered, however, that in its remarkable deposits of umber, ochre and "terre verte" the Island appears to possess the raw materials for a useful industry in mineral paints.

*Other Minerals.*—In addition to the above-named minerals, which are produced in and exported from the Island, the presence of zinc ore, magnesite, marble and salt has been proved. Magnesite occurs in large quantities in the north-west corner of the Island, and the deposit was worked some three years ago, but operations have since been suspended.

Prospects for the future regarding the further investigations of the mineral resources of the Island appear to be good, and it is understood that the Hellenic Company of

Chemical Products and Manures propose starting a drilling campaign on areas near Mitsero and Kappedhes.

### Fiji

The Director of the Imperial Institute has received from the Commissioner of Lands, Suva, Fiji, the following statement as to the mineral position in Fiji :

Mining in Fiji is still confined to prospecting operations only. No deposits of any metal have yet been found to occur in payable quantities. Gold, silver and copper are the principal metals sought for. Deposits of calcium phosphate are known on certain islands in the south-east part of the group, but do not appear to be of sufficient quantity or quality to justify working for export. Little more than traces have been found of lead, tin, zinc, nickel and iridium. Asbestos of short staple has been found in one locality and a deposit of siliceous clay on one island. The latter is said to be suitable for the manufacture of good quality firebricks, but is not worked. Oil and coal indications so far discovered have not appeared to be of sufficiently promising character to justify the expense of test bores. No geological survey has yet been made other than general surveys by visiting geologists.

The building materials mostly used in the Colony are wood and concrete. There are large deposits of limestone, approaching marble in texture, but the cost of quarrying and transport renders the cost too great for use as a building material. Bricks have been manufactured, but the quality has not been entirely satisfactory, due to imperfections in the clays used. Further investigation is required before bricks of first-class quality can be manufactured and sold at prices sufficiently low to induce builders to use them in preference to wood or reinforced concrete.

### NIGERIA

The Director of the Imperial Institute has received from R. C. Wilson, the Director of the Geological Survey of Nigeria, the following report relating to the progress of the Survey work during 1927 :

*Gold.*—On the conclusion of the geological survey of the tinfields it was decided to undertake an examination of a belt of country running from the vicinity of Minna to Birnin Gwari, from which for some years small quantities of alluvial gold have been won. The gold appears to be sparsely distributed and very little has yet been found *in situ*. Geologically the country consists mainly of ancient gneisses of various kinds with several prominent

belts of schists, both sets of rocks being extensively riddled in all directions by quartz veins and stringers. Investigations point to the fact that it is, however, the quartz veins which are associated with the schist belts and more particularly those of arenaceous type that are gold-bearing. Further work is now in progress, which it is hoped will throw some light on this problem. No terrace deposits have yet been located.

*Lead.*—A district about forty miles west of Kano, from which galena had been reported, was also investigated. The galena was found in thin stringers in the country rock, but the deposit has no commercial value.

*Platinum.*—A further examination was made of the Rano district of Kano Province from which a specimen of mineralised quartz showing a content in platinoids of 1.2 dwt. per ton, had previously been collected. Results, however, were disappointing, and this find is not likely to be of any commercial value.

*Clays.*—Further trials carried out at the Imperial Institute on clays associated with the lignite group and the Benin Sands were satisfactory and confirmed their suitability for the manufacture of refractory bricks and, with suitable admixtures, of coarse pottery.

*Black Coal.*—The coal-bearing beds of the southern part of the Enugu field have been investigated and mapped in some detail. The coal measures outcrop principally in the Oji Valley and in the upper and middle Mamu, west of Awlaw. In the latter locality a seam 3 ft. 9 in. in thickness was located. Westward of the escarpment the Coal Measures are overlain unconformably by the Pebbly Sandstone group which, in some places, rests directly on a coal seam. In this part, therefore, the Upper Sandstones and no doubt much of the Coal Measures themselves were removed by denudation before the deposition of the Pebbly Sandstone.

*Lignite.*—The lignite beds of the Imo Valley have now been traced almost without a break to the Niger Valley, where they join up with the Newi-Oba field, which has been known for some years. Beyond Oba the lignites are lost under a thick mantle of Benin Sands. Many new exposures have been found, the biggest of which measures from 9 to 10 ft. in thickness. The quality of the lignite is maintained throughout, and low-temperature carbonisation trials on a laboratory scale have demonstrated that it is suitable for this method of distillation, and that it yields about 42 gallons of crude oil per ton.

*Oil.*—Along the Awgu-Okigwi escarpment near Awgu, bitumen has been found in some small streams impregnat-

ing the base of the Pebbly Sandstone group and, in addition, there is a little thick oil which seeps out from the face of the exposure. Small quantities of this material were collected from the surface of pools and submitted to the Imperial Institute for examination. Results showed that it was very similar to that obtained by the Nigerian Bitumen Corporation from the Western Provinces some years ago.

### NYASALAND

The Director of the Geological Survey of Nyasaland reports to the Director of the Imperial Institute that, during 1927, the work of the Survey included an examination of the Zomba and Malosa plateaux with special reference to the bauxite deposits, samples from which were sent to the Imperial Institute for examination and report.

Later, a re-survey of the area between the Chiromo and Sumbu coalfields was undertaken. In the course of this work special attention was paid to the possible occurrence of additional coal deposits between the Chiromo and Sumbu areas. As a result of this examination two new outcrops of coal measures were recorded, and additional information was obtained regarding the occurrence of coal measures beneath the alluvium lying west of the Shire. New outcrops of limestone were also observed, and samples from two of these were collected for subsequent examination.

*Bauxite of the Zomba Plateau.*—The presence of concretionary bauxite on Zomba plateau has previously been recorded by the Survey, and in view of the occurrence of bauxite on Mlanje and the similarity of the physiological conditions there to those on Zomba plateau, it was considered desirable to investigate the Zomba deposit in greater detail.

The Zomba plateau consists of undulating grassland that covers an area of fully ten square miles; it stands at an elevation of 5,800 to 6,000 ft., and is bounded by steep scarps that are locally as much as 3,000 ft. in height. At many places, the paths traversing the plateau are covered with reddish-brown bauxitic concretions; these are frequently of cylindrical or branching form, and while they usually range from  $\frac{1}{2}$  in. to  $1\frac{1}{2}$  in. in length, they are sometimes much larger.

A series of eleven trial pits, ranging from 6 to 10 ft. in depth, were put down over a distance of about three miles along the path that extends from the northern foot of Chiradzulu Peak to Land's End; the path runs parallel

with the Domasi Valley and continues more or less along the Domasi-Mlungusi watershed. A twelfth pit was put down on the path that runs from Land's End towards Zomba.

An examination of the sub-soils of Malosa plateau north of the Domasi Valley was also made, but these were found to be rather less bauxitic than those of Zomba plateau.

In general, the sections in the pits showed the following sequence in descending order : (4) dark loamy soil, with bauxitic concretions, 9 in. to 1 ft. in thickness ; (3) reddish-brown sub-soil, with few concretions, 1 to 2 ft. in thickness ; (2) reddish-brown sub-soil, crowded with concretions ; this is 2 to 5 ft. in thickness and passes downwards into (1) weathered hornblende-syenite, variably bauxitised, the exposed thickness of which is 6 ft., the actual thickness being much greater.

The concretions of (2) are sometimes in the form of pisolite and sometimes in the form of a coarse rubble.

The results of the examination at the Imperial Institute of the samples collected, show that the quality of the bauxite falls short of that required at present for the production of aluminium. Some of the samples, however, represent material of promising quality for refractory purposes, and others represent material that may prove useful in the manufacture of aluminous cement.

The analyses indicate (a) that the concretions from shallow depths tend to yield bauxite of best quality, but they are followed closely by the samples of bauxitised syenite from depths of 1 to 7 ft. ; (b) that the bauxitised syenite shows a steady falling-off in quality from the surface downwards ; and (c) that the concretionary sub-soil, which passes downwards into the bauxitised syenite, shows no regular variation with depth, and on the whole it yields bauxite of quality inferior to that of the bauxitised syenite.

*The Coal-Boring Operations at Chiromo.*—At the beginning of the year Bore-Hole No. 4 at Chitumba, on the Tangasi River, near Chiromo, had been carried to a depth of 142 ft. 6 in., through 94 ft. of superficial deposits, and 48 ft. 6 in. of Karroo marls and sandstones. Carbonaceous shales came in at 192 ft., and these alternated with barren shales, mud-stones, sandstones and grits to a depth of 460 ft. The plant was then removed to site No. 5, half-a-mile lower down the Tangasi, and by the end of the year this bore-hole had reached 321 ft., through 61 ft. of superficial deposits and post-Karroo pebble-beds, and 240 ft. through Karroo red and grey sandy marls and sandstones, and grey shales. It was anticipated that early in the following



year the coal-boring work would cease with the sinking of Bore-Hole No. 6 near Nantana, still further down the Tangasi.

*The Occurrence of New Coal Deposits between the Sumbu and Chiromo Areas.*—In his comments upon the various reports submitted concerning the coal deposits of Sumbu and Chiromo, Sir John Cadman supported the view that boring operations might well be carried out through the alluvium of the Shiré Valley lying west of the line of the Mwanza Fault ; in consequence of the opinion so expressed, combined with the subsequent recommendation for a railway reconnaissance survey up the Shiré Valley and to the Sumbu coalfield, it appeared desirable to re-examine the whole area of Karroo sediments and lavas that extends along the western side of the Shiré Valley between Sumbu and Chiromo. This re-examination has revealed the existence of two new patches of coal measures in the area and has also thrown additional light on the possible occurrence of coal beneath the Shiré alluvium ; but at the same time it has shown that the Sumbu coalfield is likely to remain the only important potential source of coal in this part of the country.

Of the two new outcrops of coal measures the first, situated in the neighbourhood of Chalimba, lies on the Anglo-Portuguese Border and extends for several miles on either side, while the second runs along the Border near Nyatanda Hill and extends westward into Portuguese territory.

The Chalimba outcrop is bounded very largely by two converging faults, which bring it against the Upper Sandstone on two sides ; it is about eight square miles in area, and consists of a group of shales, coal shales and sandstones which rests upon thick-bedded grits, and is succeeded by thin-bedded sandstones ; this shale group would accordingly appear to be equivalent to the Lower Shales of the neighbouring Sumbu area. The outcrop is probably too small and too much intersected by faults to be of any immediate economic value.

The Nyatanda occurrence is the continuation of the Sumbu outcrop which has been thrown south-westward between the Pwadze Fault on the north-west and another fault to the south-east. It is bounded on the north by the Lower Sandstone, which forms the relatively high ground that determines the watershed followed by the international boundary ; to the south-west it is succeeded by the Middle Sandstone, which passes under the Lupata Sandstones and lavas that here step across the Karroo strata and give rise to the Domue scarp.

The outcrop is about twenty-five square miles in area, and it comprises both the Upper and the Lower Shales of the Sumbu area, separated by the Tapasa Sandstones.

As regards the occurrence of the Shale Group beneath the Shiré alluvium west of the Mwanza Fault, while it is not possible to obtain any conclusive information on this point without boring, the available evidence, although lending additional support to the views already expressed, nevertheless indicates that these rocks if present are intersected by innumerable faults ; moreover, they are overlain not only by the alluvium, but also by the sediments of post-Karoo age, and the combined thickness of these two formations probably amounts to several hundred feet. Consequently, from consideration of these two factors, together with the probability of encountering water in the alluvium, it may be regarded as certain that these beds could never compete in commercial development with those of the Sumbu area, which are only 10 miles distant and are satisfactorily exposed at the surface of the ground.

*Limestones associated with the Karroo Series.*—In addition to the limestones previously recorded from the Shale Group, limestones of several types occur also on the Karroo rocks intervening between the Sumbu and Chiromo areas. For example, sedimentary limestones occur on at least two horizons. At one of these, bedded magnesian limestone, of which the analysis (a) is given below, is associated with calcareous shales and soft sandstones and marls at the head of the Nsungwe Stream several miles south-west of Mbuzi. At a second locality, towards the top of the Upper Sandstone, in a stream-bed about three miles north of Chirunda Hill, nodules of limestone ranging up 2 ft. in length occur interbedded with grey sandstone, and the analysis (b) of this limestone indicates that it should be suitable for use in the production of Portland cement if used in conjunction with a suitable clay ; it could also be used to give a fair quality " fat " or plasterer's lime, but, owing to the small quantities of iron and alumina present it would be unsuitable for the manufacture of natural cement or hydraulic lime. Analyses of these two limestones at the Imperial Institute gave the following results :

#### *Analyses of Limestones*

	(a)	(b)
	<i>Per cent.</i>	<i>Per cent.</i>
Lime . . . . .	29.62	51.60
Magnesia . . . . .	19.70	0.86
Ferric oxide } . . . . .	1.00	0.70
Alumina . }		
Silica . . . . .	5.30	5.20
Loss on ignition ( $H_2O$ & $C_2O$ ) . . . . .	44.20	40.59

Many other occurrences of limestone are due to hydrothermal activity that took place at some date subsequent to the extrusion of the Karroo lavas; while certain of these limestones consist largely of coarse calcite, others are probably too highly siliceous to be of commercial value. Moreover, large deposits of travertine, variably admixed with sand and pebbles, have been formed in the beds of numerous streams that flow in their upper courses across the basalts of Wurukanyama and other neighbouring hills; amongst such streams may be mentioned the Nyakasulu, Chimpamira, Nyakamba, Mbir, Ndidiyama, and Mafume.

### SIERRA LEONE

In a communication to the Director of the Imperial Institute, the Director of the Geological Survey of Sierra Leone, N. R. Junner, gives the following interesting information with reference to the recently discovered deposits of platinum and iron ore in that Colony.

*Platinum.*—The proved platiniferous area is situated in the Sierra Leone Peninsula and is centred on a point about ten miles south of Freetown. The area extends along the coast from near False Cape (Ref. War Office Map, Sierra Leone, Sheet Ronieta, Scale 1:250,000) to near John Obey and inland into the Forest Reserve—an average distance of between two and three miles. Small amounts of platinum have been found in other areas in the Peninsula.

The platinum occurs as native metal associated with ilmenite and magnetite in small nuggets, as fairly coarse grains, and as dust in the gravels in the stream beds, alluvial flats and in beach gravels. An analysis made at the Imperial Institute of the crude platinum washed from the gravels gave: platinum, 87·0; osmiridium, 1·3; palladium, 2·0; iron, 9·9 per cent.

The bed rocks of the Sierra Leone Peninsula are various types of norite, pyroxenite, anorthosite and peridotite, with segregations of ilmenite and titaniferous magnetite. No systematic examination of these rocks for platinum has been made, but assays of certain samples collected show the presence of small amounts of platinum.

*Iron Ore.*—A recent rapid examination of parts of the Northern Province indicates the existence of a belt at least sixty miles long and averaging between ten to fifteen miles wide, containing at intervals deposits of hæmatite. The belt trends in a N.N.W. direction parallel to the trend of the rocks, and extends from the Great Scarcies River, between Banguraia (S.W. of Bassia) and Kukuna, to a few miles south of the River Rokell, between Rokon and

**Maiula.** The belt crosses the Mabole River between Rotokolon and the confluence with the Little Scarcies River. No work has yet been done in the southern part of the Masimera Chiefdom or in the Ronieta Chiefdom to discover whether the belt persists in a S.S.E. direction.

The rocks in this belt are sericite- and muscovite-schists and gneisses, which are intruded in many places by granite. The hæmatite occurrences are in practically all cases directly associated with silvery sericite- and muscovite-schists. The hæmatite-bearing belt of rocks is bounded on the E.N.E. side by the Rokell River series of shales, sandstones and lavas, and on the W.S.W. side by a belt of hornblende-schists and gneisses. No deposits of hæmatite have been found in either of these belts.

In the hæmatite belt, deposits of hæmatite which are worthy of investigation have been found at the following places in addition to Marampa, namely: Rotuma, 1½ miles south of Yonipet (Masimera Chiefdom); near Kalangba, four miles N.W. of Marampa; and at Roman-kene close to the village of Magbolonto (Sanda Magbolonto Chiefdom), about sixteen miles east of the Great Scarcies River at Kambia. A sample sent from the last-mentioned locality is practically pure hæmatite, and if there is available a large quantity of ore similar in quality to the sample, the deposit may be of commercial importance, as it is favourably situated.

It appears, therefore, that a careful search of the belt indicated may reveal the presence of important deposits of hæmatite ore.

In a communication received by the Director of the Imperial Institute from the Acting Commissioner of Lands and Forests of Sierra Leone, an account is given by F. J. Martin, Agricultural Chemist, of recent work carried out by the chemical section of the Division of Research on Soils in that Colony.

*Soil.*—During the past three years soil survey work has systematically been carried out in the Colony and Protectorate of Sierra Leone, and about 1,500 samples have been collected by agricultural chemists, superintendents of agriculture and forest officers. In accordance with instructions issued, the soil has been sampled in a uniform manner to a depth of 4 ft., and descriptions of the soil, vegetation and surrounding country have been submitted with the samples. Sufficient information has been collected in this way to allow a very fair idea to be formed of the types and distribution of soils throughout the country, and it is hoped that a soil survey of Sierra Leone will be published some time during 1928.

**Laterite and Lateritic Soil.**—The composition and properties of laterite and lateritic soils have formed one of the first problems to be tackled by the chemical staff, and as a result of chemical analysis it has been found that the greater part of the soil of Sierra Leone is lateritic, that is, contains a high proportion of alumina to silica. A paper embodying the results of the first stage of this research was published in the *Journal of Agricultural Science* (1927, vol. 17, pp. 530–47). The composition of some Sierra Leone soils was given, and definitions of laterite and lateritic soil were discussed. It was shown that certain definitions, however suitable from a geologist's point of view in defining rocks, are not suitable from the soil chemist's point of view in defining soils. It was suggested that as the clay fraction is regarded as the most important fraction in determining the reactions of a soil the classification of laterite and lateritic soils should be based on an examination of the clay fraction. It was further suggested that where the silica/alumina ratio of the clay falls below 2.0 the soil should be regarded as lateritic and where this ratio falls below 1.33 the soil should be described as laterite : soils in which the silica/alumina ratio of the clay fraction exceeds 2.0 should not be described by any term denoting a high proportion of alumina to silica.

Further investigations show that these soils are low in mineral plant foods as indicated by the amount of phosphorus and potash soluble in hydrochloric acid, while the exchangeable bases are also low, the exchangeable calcium being about 0.08 per cent. in the few samples examined.

### SOUTHERN RHODESIA

The Director of the Imperial Institute is indebted to the Director of the Geological Survey of Southern Rhodesia for the following report by F. E. Keep, the Government Mining Geologist, dealing with work carried out by him recently on deposits of asbestos and barytes in Southern Rhodesia.

**Asbestos.**—Owing to a pressing demand on the part of the mining companies engaged in winning chrysotile asbestos fibre at Shabani, Belingwe District, the Government Mining Geologist commenced work in the area in September 1926, and finished in January 1928. During this time a large area surrounding the mines was topographically and geologically mapped, every accessible underground working place visited and a thorough study made of the manner of occurrence, alteration and origin of the chrysotile fibre and associated rocks.

It was discovered that the asbestos occurred in the Shabani neighbourhood only in serpentine derived from a dunite or rock composed solely of olivine. The relative ages of the commercial and brittle fibres were investigated, the conclusions arrived at being that the brittle useless fibre was a partially talcified fibre and, as such, the result of alteration by dynamic and, to a lesser degree, by hydrothermal metamorphism.

The probability or otherwise of the deposits continuing at depth was also studied, it being concluded from the available evidence that unless a zone of metamorphosed (silicified and/or carbonated) asbestos-bearing serpentine were encountered in any particular producing body, with the consequent destruction of the valuable fibre, the body should continue at depth. It is pointed out that, owing to the eccentricities of shearing action in the Pre-Cambrian rocks in which the deposits are located, no forecast as to the probability or possibility of the sheared rocks being met with unexpectedly at any particular horizon can be given. It is apparently unlikely that any really serious trouble will be encountered owing to this cause, although certain horizons of the fibre-bearing rocks will probably be restricted and reduced in size as compared with other horizons, owing to the talcification or partial talcification of the rocks, consequent upon shearing having taken place.

It is considered that both serpentinitisation and formation of asbestos fibre are due to the same agencies, the principal one having been the action of the volatile or fugitive elements accompanying the intrusion of the granite, in which rock the dunite-serpentine-talc rock mass occurs to-day in the form of a xenolith, having an outcrop area of some twenty square miles, not all of which is, however, asbestos-bearing.

The serpentinitisation has not proceeded throughout the rock mass, the limit of payable asbestos-bearing ground being soon reached as one recedes from the granite contact and enters the partially serpentinitised zone in the central portions of the mass.

The analyses of the various types of fibre tend to show that the nearer a fibre corresponds in chemical composition to the theoretical composition of a serpentine the better quality the fibre is found to be. It is to be noted that a small excess of combined water is not detrimental, but that in no case was an asbestos fibre which contained an excess of silica, or was deficient in combined water, of the best quality for commercial purposes.

On June 29, 1927, the Government Mining Geologist read a paper before Section B of the South African Associa-

tion for the Advancement of Science giving the results of his researches on the occurrence of chrysotile asbestos in the Shabani area up to that date. This paper may be referred to in the *South African Journal of Science*, 1927. He is at present engaged upon a complete work dealing with this subject, to be published by the Southern Rhodesia Geological Survey during the present year.

*Barytes*.—This report embodies the results of observations made by the Government Mining Geologist in the vicinity of Gado Siding, Gwelo District, during a short visit to the area in June 1927. The principal deposits of barytes occur upon Redfields Farm, situated about eleven miles south from Que Que and three miles from Gado Siding, and are located between the old Gwelo-Que Que road and its new alinement which crosses the Kwekwe River by means of a low-level bridge at a distance of approximately 1,600 ft. eastwards from the old drift.

The presence of occasional ellipsoidal structure, or "pillows," in outcrops of the felsite in the Kwekwe River, where shearing has not been extreme, is proof that the felsite was originally a lava of intermediate to sub-acid composition.

The largest lenses of barytes occur in zones situated south from the Kwekwe River between the old and new Que Que-Gwelo roads at a distance of from 150 to 350 yards from the river, and are located in a series of terraces of quartz and silicified felsite. The most northerly terrace has a length of strike of approximately 300 yards, and contains irregular lenses and pockets of coarsely crystallised as well as fine-grained barytes, the lenses varying from one foot in length and a few inches in width to 100 ft. in length and 30 ft. in width. The barytes from these lenses is of great purity and is occasionally stained pink by oxide of iron, no other metallic salts having been noted except rare patches of galena and a little iron pyrites in the barytes. No carbonates of barium, strontium or calcium, the usual impurities present in barytes, were seen.

At a very conservative estimate at least 100,000 long tons of high-grade barytes must exist within 15 ft. in depth of the outcrop of the lenses. As there is no reason to believe that the deposits will not continue to several times that depth, as shown by the adit and Shaft No. 2 (Shaft No. 1 was inaccessible at the time of the Mining Geologist's visit), it may be taken that sufficient barytes to supply any possible demand that is likely to arise for many years can be produced from the area under review.

Apart from occasional iron-staining and patches of galena, the barytes is of extreme purity and it would be a

matter of no great difficulty for the owners to hand-pick the ore, rejecting any which contained galena or was heavily stained, if such were necessary.

Two samples assayed in Johannesburg are stated to have yielded over 98 per cent.  $\text{BaSO}_4$ , while assays of samples made in 1924 gave the following results : " white " barytes 95.18 per cent.  $\text{BaSO}_4$ , " pink " (iron-stained) barytes 85.64 per cent.  $\text{BaSO}_4$ .

Carbonated waters containing sodium chloride, percolating through a barium- and lead-containing rock, such as an acid lava, would be converted into a comparatively strong solution of barium chloride and carbonate and a weaker solution of lead chloride. Upon coming in contact with acid waters of the type mentioned above, barium sulphate and lead sulphide would be precipitated, with the formation of deposits such as those found near Gado Siding.

### TANGANYIKA TERRITORY

The Director of the Imperial Institute has received from Gregson Williams, the Controller of Mines of Tanganyika, the following report on mining progress in that Territory during 1927 :

*Gold*.—The output of gold exceeds that of the previous year by approximately 1,500 oz. The increase is largely due to a new " strike," in the locality of the Lupa River, made in March. The gold won was for the most part remarkably coarse, nuggets up to 120 oz. in weight being recovered. Lack of water prevented operations after the cessation of the rains, and it is not yet known whether this deposit will prove to be of importance, although the shallowness of the auriferous gravels would suggest early exhaustion. Increased activity in the search for reef outcrops resulted in the pegging of the considerable number of claims. Practically all these claims have been acquired under option by an important Rhodesian company, as the outcome of a visit paid by the Manager. Preliminary work on the reefs of this district justifies optimism for the future.

Development of the gold occurrences of Mwanza Province has been disappointingly slow, though the output has somewhat increased. The installation of a nine-stamp battery at Kilimafeza Mine was completed during the year, and arrangements were made to conserve water, which rapidly becomes scarce in this locality as soon as the dry season sets in. For this reason crushing was delayed until the end of the year.

Small stamp batteries have been erected at Nyasirori, Maji Moto and Buhemba ; production should increase



from these small mines during the forthcoming year. The long outcrop at Majita and the "Bismarck-reef" near Emin Pasha Gulf have been covered by exclusive prospecting licences.

Development on the ex-enemy claims held by the Tanganyika Exploration Syndicate has turned out to be disappointing, and the hopes, expressed in a published report, of proving an extensive orebody have not been fulfilled.

During the year, negotiations in South Africa resulted in the formation of a company to take over the Sekenke Gold Mine. The possession of ample funds will ensure the unwatering of the mine, and its vigorous development.

A report has been received that an experienced prospector has discovered gold, both alluvial and reef, to the west of Biharamulo, near the Irundi border. Details are, as yet, lacking.

*Tin.*—As a result of further prospecting, the stanniferous area in Bukoba Province has been found to extend to the south of Lake Lufunza and up to the shores of Lake Ruenyana. The area covered by exclusive prospective licences granted or under application is approximately 400 square miles. Five applications have also been received covering ground adjacent to the Rovuma River, on the Belgium border, almost due west of Biharamulo. It is doubtful whether cassiterite has actually been found in this locality, though geological conditions are similar to those of the Kyerwa tinfield. The leases held by Mrs. A. Kargarotos at Kyerwa have now been assigned to the newly formed company, the Bukoba Tinfields, Ltd., who have started mining operations. Prospecting, while proving the presence of detrital tin over a wide area, has not so far revealed a deposit of any great extent. The deep banks of the Kagera River can only be satisfactorily tested by drilling, and it is hoped that this operation will be undertaken shortly under expert technical supervision. Such supervision has hitherto to a great extent been lacking in connection with the not inconsiderable prospecting carried out in the district. This state of affairs partially explains the fact that no definite conclusions as to the potentialities of the tinfield have been arrived at.

A road from Kyerwa to Kigagati on the Kagera River was started by a number of licence holders, and is subsidised by Government. Connection by road to mile 104 on the river will provide an outlet by water, and will greatly facilitate future prospecting in the district.

*Diamonds.*—The output of diamonds from the deposit at Mabuki, near Mwanza, amounted to 18,152½ carats,

valued at £95,600. The Mwanza Syndicate decided not to exercise the option over the property, and accordingly the mine reverted to the lessees as from June 30. In spite of the effect on the market of the greatly increased output of alluvial diamonds in South Africa, the average value of the Mabuki stones remained high. The largest stone recovered weighed 52 carats, and a considerable number of the stones found exceeded 10 carats. In addition to winning diamonds, it is the intention of the lessees to develop vigorously the property and to test the value of the pipe in depth. Arrangements for the sinking of a shaft to the depth of 500 ft. were being made at the end of the year.

Work on the precious stones claims surrounding the mine has been intermittent, and with the exception of one or two small stones no discoveries have been reported.

A large number of individuals were prospecting for diamonds in the Shinyanga District. Pegging has been concentrated at two points, one south of the new Shinyanga Station, and the other north of the Usagore-Ibadakule Road. A few small stones have been reported, one of which came from Usagore. North of that place, a pipe of kimberlite type has been discovered, and there is evidence that kimberlite-bearing fissures must be spread over a large area of the district. The locality would appear worthy of expert examination.

*Coal.*—At the beginning of the year, a sample of coal from the Ufipa field was delivered to the Railway Administration in order that a practical test of its quality might be conducted.

It can be said that the result of this test was on the whole favourable, more particularly when it is remembered that the coal was obtained from but little below the outcrop.

A substantial company has acquired an option over the claims, and mining and geological staff arrived in October for the purpose of examining the potentialities of the field.

*Mica.*—The output of mica has again been disappointing, there being a decrease as compared with that for the previous year. The District of Morogoro has again yielded the largest production, and a considerable number of new claims were pegged towards the end of the year in that locality. A new occurrence of the mineral to the south-west of Lake Rukwa has received attention; the mica so far produced therefrom has proved to be of excellent quality and has commanded a high price.

*Copper.*—The copper occurrence in the Njombe Dis-

strict is being tested by a diamond drill. One bore-hole has been abandoned after reaching a depth of over 300 ft., and a second is in process of being drilled. No positive results had been obtained at the end of the year.

An interesting discovery of an auriferous copper deposit was made towards the close of the year near the Lupa River. The assay of surface samples proved satisfactory values in the case of both metals.

Other occurrences have been pegged under claim or licence in Njombe and near Mpwapwa. It is expected the deposits of the latter place will be examined by geophysical methods.

*Salt.*—There has been a satisfactory increase of over 1,600 tons in the output of salt. The total production amounted to approximately 4,775 tons, of which over 3,300 tons were won by the Uvinza Salt Works. It is expected that the company of which the Government hold half the share will greatly increase its production in the near future.

*Other Minerals.*—Ochre is mined near Arusha, 27½ tons having been won during the year.

From the Luisenfelde Mine, in Lindi District, 111 lb. of garnets were exported during the same period.

## UGANDA

In a communication to the Director of the Imperial Institute, E. J. Wayland, the Director of the Geological Survey of Uganda, states that the field work of the Survey has been somewhat restricted during the six months ending June 30, owing chiefly to the absence of officers on home leave. The prospecting of the alluvial gold deposits of the Kafu River and the geological survey of the Kafu Basin, begun at the end of 1925, were, however, completed in May, when the field officer concerned returned to Headquarters to continue the work of the Petrologist and Chemist, who proceeded to England on leave in April.

The geological mapping carried out during 1925-26 by A. D. Combe in Kigezi showed clearly that over a great part of that district similar geological conditions obtained to those of known tin-bearing areas in Ankole. The knowledge thus obtained has borne fruit during the period under review in further discoveries of tin by prospectors acting on information made available by the Geological Survey. Promising discoveries have thus been made on the border of Ankole and Kigezi and as far west as Ruhuhuma, on the outskirts of the lava fields of Mufumbiro.

Drilling operations in connection with the search for

coal in the Karroo Beds of Entebbe Peninsula are temporarily suspended during the absence on leave of the Drilling Engineer. These operations have been, and will continue to be, guided by information obtained from prospect pits put down through the laterite at salient points; and further work in this connection has extended our knowledge of the folding of the Karroo beds and of the basement schists-with-granite on which they lie. Beds of carbonaceous and calcareous shales are prominent at depth in the borehole now in hand; thin partings of coal also occur, and on the whole the succession is regarded as encouraging for further work.

Reverting to the examination of the Kafu alluvials, the extension of the work downstream, beyond the length of river dealt with in the Annual Report for 1926, has definitely proved that no workable "lead" exists in any of the gravel deposits. The gold is widespread, and taken *in toto*, is in great quantity, but on no level has there been sufficient concentration. The scientific results, however, are of peculiar interest and importance; on the one hand the high-level gravels, with the differential tilting movements of which they provide indisputable evidence, throw a great deal of light on the tectonic history of the country in the Pliocene and Pleistocene; while on the other hand the study of the Karagwe-Ankolian sediments of Eastern Bunyoro and their relations to the Basement Schists and Granite, and the interesting structural features of the region, complete our knowledge of the outline of the geology of Bunyoro as a whole, so desirable in the study of the problems of the Western (Albertine) Rift Valley.

*Headquarters' Work.*—Owing to the interest aroused of late in the mineral potentialities of Uganda, and the consequent ever-increasing scale of prospecting activities, much of the Petrologist's time has been employed in making identifications, assays, etc., for members of the public. In addition to the usual gold and silver assays, the office has now taken in hand the assaying of tin.

Petrological work has been commenced on a collection of the lavas of the Mufumbiro field, on the dolerites of Uganda and to some extent on the granites, *pari passu* with the description and cataloguing of the rock slides in the Geological Survey collection.

The Mufumbiro lavas prove to be an eminently alkaline suite, consisting chiefly of leucite basanites and leucite tephrites, and most interesting conclusions are to be expected from an extended study and comparison with other East and Central African alkaline provinces.

The dolerites so far studied are olivine-free, usually

enstatite-bearing, and appear to be magmatically connected with certain enstatite-granites tentatively referred to in Annual Reports of this Survey as charnockites ; and it is highly probable that these enstatite rocks will be proved to belong to one phase of igneous activity manifested throughout the country.

## BIBLIOGRAPHY

*Comprising the more important reports, articles, etc., on plant and animal products, contained in publications received in the Library of the Imperial Institute during the three months February–April 1928.*

*The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.*

### AGRICULTURE

#### General

Empire Marketing Board. A Year's Progress. Pp. 40, 9½ × 7½. (London : Empire Marketing Board, 1927.)

Agricultural Economics in the Empire. Report of a Committee appointed by the Empire Marketing Board. *Empire Marketing Board, Public. No. 1.* Pp. 24, 9½ × 7½. (London : Empire Marketing Board, 1927.) Price 6d.

Tropical Agricultural Research in the Empire, with Special Reference to Cacao, Sugar Cane, Cotton and Palms. By C. A. Barber. *Empire Marketing Board, Public. No. 2.* Pp. 77, 9½ × 7½. (London : H.M. Stationery Office, 1927.) Price 1s. 6d.

Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1926–27. Pp. 157, 9½ × 6. (London : H.M. Stationery Office, 1928 [Cmd. 3002] .) Price 3s.

Agricultural Research Council. Reports on the Work of Research Institutes, 1926–27. *Council Paper No. 80.* Pp. 109, 13½ × 8½. (London : Ministry of Agriculture and Fisheries, 1928.) Mimeographed copy.

Scientific Reports of the Agricultural Research Institute, Pusa, 1926–27. Pp. 142, 10 × 7. (Calcutta : Government of India Central Publication Branch, 1928.) Price Rs.1–14 or 3s. 3d.

Annual Report of the Department of Agriculture, Bengal, for the Year 1926–27. Pp. 373, 9½ × 6½. (Calcutta : Bengal Secretariat Book Depot, 1927.) Price Rs.5–6 (9s.).

Report of the Agricultural Department, Bihar and Orissa, for the Period from the 1st April, 1926, to the 31st March, 1927. Pp. 77, 9½ × 6½. (Patna : Superintendent, Government Printing, 1927.) Price Rs.2.

Report on the Operations of the Department of Agriculture, Burma, for the Year ended the 30th June, 1927. Pp. 30, 9½ × 6½. (Rangoon : Superintendent, Government Printing, 1927.) Price Re.1 (1s. 6d.).

Mysore Agricultural Calendar, 1928. Department of Agriculture, Mysore. Pp. 50, 9½ × 6½. (Bangalore : Government Press, 1928.) Price As.2.

Report on the Operations of the Department of Agriculture, Punjab, for the Year ending 30th June, 1926. Part II: Annual Record of Experimental Work. Vol. I, pp. 139,  $13\frac{1}{2} \times 8\frac{1}{2}$ , price Rs.5-8 (7s. 4d.); Vol. II, pp. 236,  $13 \times 8\frac{1}{2}$ , price Rs.9 (12s.). (Lahore: Superintendent, Government Printing, 1928.)

Annual Report of the Agricultural Officer, Kedah, for the Year 1345 (1926-27). Pp. 8,  $13 \times 8$ . (Typewritten copy.)

Bulletin du Département de l'Agriculture et de la Pêche, Seychelles. Bull. No. 8. Pp. 9,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Victoria—Mahé, Seychelles: Government Printing Office, 1927.)

Annual Report of the Department of Agriculture, Gambia, for the Period January 1st, 1926, to March 31st, 1927. Pp. 53,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (London: Crown Agents for the Colonies.) Price 5s.

Sixth Annual Bulletin of the Agricultural Department, Nigeria, 1st August 1927. Pp. 264,  $10\frac{1}{2} \times 8$ . (Lagos: Government Printer, 1927.) Price 5s. post free.

Annual Report of the Department of Agriculture, Nyasaland, 1926. Pp. 28,  $13 \times 8\frac{1}{2}$ . (Zomba: Government Printer, 1927.)

Annual Report of the Lands and Forests Department, Sierra Leone, for the Year 1926. Pp. 59,  $12\frac{1}{2} \times 8$ . (Freetown: Government Printing Office, 1927.)

Report of the Government Chemist, Sudan, for the Year 1927. Public. No. 50, Chem. Section, Wellcome Trop. Res. Laboratories, Khartoum. Pp. 30,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Khartoum: Wellcome Tropical Research Laboratories, 1928.)

Annual Report of the Department of Agriculture of the Province of New Brunswick for the Year ended October 31st, 1927. Pp. 151,  $10 \times 6\frac{1}{2}$ . (Fredericton, N.B.: Department of Agriculture, 1928.)

Report of Agricultural and Marine Products Board, Bahama Islands, for the Year 1926. Appendix to the Votes of the Honourable House of Assembly of the Bahama Islands. (1927, Jan.-June. pp. 383-387.)

Report on Development of Agriculture in Trinidad. By H. C. Sampson. Empire Marketing Board, Public. No. 3. Pp. 8,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (London: H.M. Stationery Office, 1927.) Price 3d.

Report on Development of Agriculture in British Guiana. By H. C. Sampson. Empire Marketing Board, Public. No. 4. Pp. 26,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (London: H.M. Stationery Office, 1927.) Price 9d.

Report on Development of Agriculture in the Leeward and Windward Islands and Barbados. By H. C. Sampson. Empire Marketing Board, Public. No. 5. Pp. 14,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (London: H.M. Stationery Office, 1927.) Price 6d.

Report on the Agricultural Department, Dominica, 1926-27. Pp. 41,  $12\frac{1}{2} \times 8\frac{1}{2}$ . (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1928.) Price 6d.

Report on the Agricultural Department, St. Kitts-Nevis, 1926-27. Pp. 30,  $9\frac{1}{2} \times 6$ . (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1928.) Price 6d.

First Annual Report of the Council for Scientific and Industrial Research, Commonwealth of Australia, for the Period from the 13th April, 1926, to the 30th June, 1927. Pp. 64,  $9\frac{1}{2} \times 6$ . (Melbourne: Government Printer, 1927.)

Report of the Department of Agriculture, New South Wales, for the Year ended 30th June, 1927. Pp. 44,  $13 \times 8$ . (Sydney: Government Printer, 1928.) Price 3s.

Sixtieth Annual Report of the Dominion Laboratory, New Zealand, 1926. By J. S. MacLaurin. Pp. 45,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Wellington: Government Printer, 1927.)

Annual Report of the Department of Agriculture, Fiji, for the Year

1926. *Council Paper*, No. 90. Pp. 16,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Suva: Government Printer, 1927.)

Agricultural Survey of Europe. France. By L. G. Michael. *Tech. Bull. No. 37, U.S. Dept. Agric.* Pp. 184,  $9 \times 5\frac{1}{2}$ . (Washington, D.C.: Government Printing Office, 1928.) Price 25 cents.

Thirty-Seventh Annual Report of the Washington Agricultural Experiment Station for the Fiscal Year ended June 30, 1927. *Bull. No. 222, Washington Agric. Exper. Sta.* Pp. 80,  $9 \times 6$ . (Pullman, Washington: State College, 1927.)

Dry Farming Methods in the Deccan. By V. A. Tamhane, N. V. Kanitkar and G. M. Bapat. *Bull. No. 142 of 1927. Dept. Agric., Bombay.* Pp. 25,  $9\frac{1}{2} \times 6$ . (Bombay: Superintendent of Government Printing, 1927.)

Report of the Director of Irrigation, Union of South Africa, for the Period 1st April, 1926, to 31st March, 1927. Pp. 21,  $13 \times 8\frac{1}{2}$ . (Pretoria: Government Printing Office, 1928.) Price 2s.

Annual Report of the Irrigation Commission, Union of South Africa, for the Period ending 31st March, 1927. Pp. 18,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Cape Town: Cape Times, Limited, 1928.) Price 1s. 6d.

First Report of the Select Committee on Irrigation Schemes, Union of South Africa. Pp. 113,  $9\frac{1}{2} \times 6$ . (Cape Town: Cape Times, Limited, 1928.)

Annual Report on the Work of the Irrigation Department, Egypt, during the Year 1923-1924. Part II. Pp. 175,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Cairo: Government Publications Office, 1928.) Price P.T.20.

Delivery of Irrigation Water. By W. A. Hutchins. *Tech. Bull. No. 47, U.S. Dept. Agric.* Pp. 48,  $9 \times 5\frac{1}{2}$ . (Washington, D.C.: Government Printing Office, 1928.) Price 10 cents.

Silt in the Colorado River and its Relation to Irrigation. By S. Fortier and H. F. Blaney. *Tech. Bull. No. 67, U.S. Dept. Agric.* Pp. 95,  $9 \times 6$ . (Washington, D.C.: Government Printing Office, 1928.) Price 20 cents.

### The Soil

The Mechanical Analysis of Tropical Soils. By J. Charlton. *Bull. No. 172, Agric. Res. Institute, Pusa.* Pp. 9,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (Calcutta: Government of India Central Publication Branch, 1928.) Price As.3 (4d.).

Fifth Interim Report of the Permanent Committee on Basic Slag. Pp. 36,  $13 \times 8$ . (London: Ministry of Agriculture and Fisheries.) Mimeographed copy.

The Effect of Phosphatic Manures on Soil Acidity. By C. R. Harler. *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1927, Part IV, pp. 199-203).

Experiments in Northern Ireland with various Types of Phosphatic Fertilisers. By G. S. Robertson. *Journ. Ministry Agric., N. Ireland* (1927, 1, 7-36).

The Maintenance of the Fertility of the Soil by the Use of Leguminous Crops. By T. Thornton. *Sixth Ann. Bull., Agric. Dept., Nigeria, 1927*, pp. 122-126.

Plantes pour engrais verts et pour couverture. By E. de Wildeman. *Rev. Bot. Appl. et d'Agric. Col.* (1927, 7, 656-661.)

Nitrogen-Fixation by *Azotobacter chroococcum*. By S. Ranganathan and R. V. Norris. *Journ. Ind. Inst. Sci.* (1927, 10A, Part VIII, pp. 79-96).

### Pests—General

Some General Remarks on the Influence of Climatic Conditions on the Prevalence of Economic Insects in Malaya. By G. H. Corbett and C. Dover. *Malayan Agric. Journ.* (1928, 16, 1-7).

The Fall Army Worm. By P. Luginbill. *Tech. Bull. No. 34, U.S. Dept. Agric.* Pp. 92, 9½ × 5½. (Washington, D.C.: Government Printing Office, 1928.) Price 25 cents.

Life History of the Codling Moth in Delaware. By E. R. Selkregg and E. H. Siegler. *Tech. Bull. No. 42, U.S. Dept. Agric.* Pp. 61, 9 × 5½. (Washington, D.C.: Government Printing Office, 1928.) Price 15 cents.

Tar-oil Wash Trials in the West Midlands, 1926-27. By S. G. Jary. *Journ. Ministry Agric.* (1928, 84, 1107-1113).

#### Diseases—General

Rules under the Diseases of Plants Prevention Ordinance, Kenya. Pp. 8, 9½ × 6½. (Nairobi: Government Printer, 1927.)

#### Foodstuffs—General

Encyclopédie Biologique. I. Les Plantes Alimentaires chez tous les peuples et à travers les Ages. By D. Bois. Pp. 593, 10 × 6½. (Paris: Paul Lechevalier, 1927.) Price Fr. 75.

The Supervision of the Food Supply and the Handling and Storage of Food. Pp. 42, 9½ × 6½. (Edinburgh: H.M. Stationery Office, 1927.) Price 3d.

#### Beverages

Brazil's Coffee Industry. Special Brazil Coffee Number of *Tea and Coffee Tr. Journ.* (1928, 4, 35-121).

Fighting Brazil's Coffee Pest (*Stephanoderes hampei*). By M. L. de Oliveira Filho. *Tea and Coffee Tr. Journ.* (1928, 4, 66-71).

The Common Coffee Mealy-Bug (*Pseudococcus lilacinus* Ckll.) in Kenya Colony. By T. W. Kirkpatrick. *Bull. No. 18, Dept. Agric., Kenya Colony.* Pp. 110, 9½ × 7½. (Nairobi: Government Printer, 1927.)

Studiën over de Vegetatieve Vermeerdering bij Overjarige Tropische Landbouwgewassen. I. Groeicijfers bij Koffie. By P. J. S. Cramer. *Arch. v. Koffiecult. in Ned.-Ind.* (1928, 2, 4-51). Also published as *Med. No. 26, Alg. Proefsta. voor den Landbouw.* Pp. 53, 10½ × 7½. (Batavia: Departement van Landbouw, Nijverheid en Handel, 1928.)

Tea Production in Tonkin, French Indo-China. By R. Lanctot. *Spice Mill* (1928, 51, 78-83).

Methods for Conducting Experiments on Factors affecting the Quality of Tea. By C. J. Harrison. *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1927, Part IV, pp. 189-198).

Vegetable Parasites of the Tea Plant (*cont.*). By A. C. Tunstall. The Blights (*Exobasidium vexans*, *Laestadia Camelliae*, *Cercospora Theae*). *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1927, Part IV, pp. 173-182).

The Influence of Manuring on Susceptibility of Tea Leaves to Brown Blight (*Glomerella cingulata*) at Borbhetta. By A. C. Tunstall. *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1927, Part IV, pp. 183-186).

The Influence of Plucking on the Susceptibility to Common Fungus Diseases of Tea Leaves. By A. C. Tunstall. *Quart. Journ., Sci. Dept., Ind. Tea Assoc.* (1927, Part IV, pp. 187-188).

#### Cereals

Co-operative Marketing of Grain in Western Canada. By J. F. Booth. *Tech. Bull. No. 63, U.S. Dept. Agric.* Pp. 116, 9 × 6. (Washington, D.C.: Government Printing Office, 1928.) Price 20 cents.

Grain Weevils (*Calandra oryzae* and *Calandra granaria*). By L. J. Newman. *Journ. Dept. Agric., W. Australia* (1927, 4, 538-545).

Studies in Cereal Diseases, I. Smut Diseases of Cultivated Plants.



**Their Cause and Control.** By H. T. Güssow and I. L. Connors. *Bull. No. 81, New Ser., Dept. Agric., Canada.* Pp. 79,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Ottawa: King's Printer, 1927.)

**Smuts of Wheat and Rye and their Control.** By W. H. Tisdale and V. F. Tapke. *Farmers' Bull. No. 1540, U.S. Dept. Agric.* Pp. 17,  $9 \times 5\frac{1}{2}$ . (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

**Grey Speck Disease of Wheat and Oats (known as White Wilt in Western Australia).** By W. M. Carne. *Journ. Dept. Agric., W. Australia* (1927, 4, 515-519).

**Corn Breeding.** By F. D. Richey. *Dept. Bull. No. 1489, U.S. Dept. Agric.* Pp. 64,  $9 \times 5\frac{1}{2}$ . (Washington, D.C.: Government Printing Office, 1927.) Price 25 cents.

**Scouting, Quarantine and Control for the European Corn Borer, 1917-1926.** By L. H. Worthley and D. J. Caffrey. *Tech. Bull. No. 53, U.S. Dept. Agric.* Pp. 143,  $9 \times 6$ . (Washington, D.C.: Government Printing Office, 1927.) Price 30 cents.

**Farm Practices under Corn-borer Conditions.** By J. W. Tapp, G. W. Collier and C. R. Arnold. *Farmers' Bull. No. 1562, U.S. Dept. Agric.* Pp. 21,  $9\frac{1}{2} \times 5\frac{1}{2}$ . (Washington, D.C.: Government Printing Office, 1928.)

**Chemical-Dust Seed Treatments for Dent Corn.** By J. R. Holbert, C. S. Reddy and B. Koehler. *Circ. No. 34, U.S. Dept. Agric.* Pp. 6,  $9 \times 5\frac{1}{2}$ . (Washington, D.C.: Government Printing Office, 1928.)

**Notes on the Blue Oat Mite (*Notophallus bicolor* Froggatt).** By J. H. Smith. *Queensland Agric. Journ.* (1928, 29, 127-131).

**Rice in Burma. Production, Trade and Improvement.** By D. Hendry. II. Trade. *Trop. Agric., W.I.* (1928, 5, 34-36, cont.).

**Consumo, produzione e commercio del riso in Giappone.** *Giorn. di Riscoltura* (1928, 18, 37-39).

**De Rijstinvvoer in Nederlandsch-Indië.** By M. B. Smits. *Med. v.d. Afdeel. Landb., No. 13, Dept. v. Landb., Nijver. en Handel.* Pp. 20,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Wetevreden: Landsdrukkerij, 1928). Price Fl. 0.50.

**Insects Injurious to the Rice Crop.** By J. W. Ingram. *Farmers' Bull. No. 1543, U.S. Dept. Agric.* Pp. 17,  $9 \times 6$ . (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

**Colour Inheritance in Rice.** By S. K. Mitra, S. N. Gupta and P. M. Ganguli. *Mem. Dept. Agric., India, Bot. Ser.* (1928, 15, 85-102).

**The Control of Sorghum Kernel Smut and the Effect of Seed Treatments on Vitality of Sorghum Seed.** By C. O. Johnston and L. E. Melchers. *Tech. Bull. 22, Kansas Agric. Exper. Sta.* Pp. 37,  $9 \times 6$ . (Manhattan, Kansas: State Agricultural College, 1928.)

**The Improvement of Indian Wheat. A brief Summary of the Investigations carried out at Pusa from 1905 to 1924, including an Account of the new Pusa Hybrids.** By A. Howard and G. L. C. Howard. *Bull. No. 171, Agric. Res. Institute, Pusa.* Pp. 26,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (Calcutta: Government of India Central Publication Branch, 1928.) Price As.8 (10d.).

**Studies in Cereal Diseases, II. Root-Rots and Foot-Rots of Wheat in Manitoba.** By F. J. Greaney and D. L. Bailey. *Bull. No. 85, New Ser., Dept. Agric., Canada.* Pp. 32,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Ottawa: King's Printer, 1927.)

**Root-rot and Foot-rot of Wheat (*Wojnowicia graminis* and *Helminthosporium sativum*).** By W. M. Carne. *Journ. Dept. Agric., W. Australia* (1927, 4, 483-488).

**The Common Barberry and Black Stem Rust.** By E. C. Stakman, F. E. Kempton and L. D. Hutton. *Farmers' Bull. No. 1544, U.S. Dept. Agric.* Pp. 29,  $9\frac{1}{2} \times 6$ . (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

*Sugar*

Economic Survey of the Sugarcane Industry in the East Central, Tenasserim and Northern Agricultural Circles. *Bull. No. 23, Agric. Dept., Burma*. Pp. 26,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Rangoon: Superintendent, Government Printing, 1926.) Price As.6 (7d.).

The Organisation and Cost of *Gul* (Crude Sugar) making in the Deccan Sugarcane Tracts. By Rao Bahadur P. C. Patil. *Bull. No. 147 of 1927, Dept. Agric., Bombay*. Pp. 18,  $9\frac{1}{2} \times 6$ . (Bombay: Superintendent of Government Printing, 1927.)

Sugar-Cane Experiments in the Leeward Islands. Report on Experiments with Varieties of Sugar-cane conducted in Antigua and Montserrat in the Seasons 1925-26—1926-27. Pp. 19,  $9\frac{1}{2} \times 6$ . (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1927.) Price 1s.

La Culture Mécanique de la Canne à Sucre spécialement aux Antilles. By A. Kopp. *Rev. Bot. Appl. et d'Agric. Col.* (1927, 7, 724-734; 837-850).

Paradichlorobenzene for Combating Cane Grubs. Introduction and Past History. By E. Jarvis. *Queensland Agric. Journ.* (1928, 29, 97-107).

Destroying Cane Grubs with Carbon Bisulphide. By E. Jarvis. *Queensland Agric. Journ.* (1928, 29, 107-113).

Gumming Disease (of Sugar-cane). By E. J. F. Wood. *Queensland Agric. Journ.* (1928, 29, 116-122).

*Root Crops.*

Source, Character and Treatment of Potato Sets. By W. Stuart, W. C. Edmundson, P. M. Lombard, and G. W. Dewey. *Tech. Bull. No. 5, U.S. Dept. Agric.* Pp. 36,  $9\frac{1}{2} \times 5\frac{1}{2}$ . (Washington, D.C.: Government Printing Office, 1927.) Price 10 cents.

Freezing Injury to Potatoes. By R. C. Wright and H. C. Diehl. *Tech. Bull. No. 27, U.S. Dept. Agric.* Pp. 24,  $9 \times 6$ . (Washington, D.C.: Government Printing Office, 1927.) Price 10 cents.

*Fruits*

Arsenic in New Zealand-grown Apples. By R. L. Andrew. *New Zealand Journ. Sci. and Tech.* (1927, 9, 206-209).

Notes on Banana Insect Pests. By J. L. Froggatt. *Queensland Agric. Journ.* (1928, 29, 15-35).

Les travaux récents sur les Aurantiées. By A. Guillaumin. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 169-176).

Citrus Fruit Growing in Rhodesia (*cont.*). By G. W. Marshall. *Rhodesia Agric. Journ.* (1928, 25, 51-77).

The Cultivation of Oranges and Allied Fruits in the Bombay Presidency. By H. P. Paranjpye. *Bull. No. 95 of 1919 (Revised, 1927), Dept. Agric., Bombay*. Second edition. Pp. 29,  $9\frac{1}{2} \times 6$ . (Bombay: Superintendent of Government Printing, 1927.) Price As.3 (4d.).

Curing and Preserving Citron. By L. McCulloch. *Circ. No. 13, U.S. Dept. Agric.* Pp. 8,  $9 \times 6$ . (Washington, D.C.: Government Printing Office, 1927.) Price 5 cents.

I centri di produzione delle uve da tavola in Italia, by F. Zago. Le migliori varietà, by V. Prosperi. Norme generali per l'impanto e la coltivazione delle viti per uve da tavola, by V. Racah. I sistemi di potatura, by A. Longo. La conservazione dell' uva, by G. Dalmasso. L'uva da tavola all'estero, by G. Briganti. La produzione ed il consumo di uva passa in Italia e negli altri paesi, by L'Ambulante. Il valore alimentare e terapeutico dell' uva, by E. Piccoli. *L'Italia*

*Agricola*. Numero speciale dedicato alle Uva da tavola (Anno 64, No. 8, Agosto, 1927, V, pp. 385-506).

Standard Methods of Drying Sultana Grapes in Australia. By A. V. Lyon. *Pamphlet No. 6, Council Sci. and Indust. Res., Australia*. Pp. 16, 9½ × 6. (Melbourne: Government Printer, 1928.)

The Chemistry of Wine Making. A Report on Oenological Research, By J. T. Hewitt. *Empire Marketing Board, Public. No. 7*. Pp. 57, 9½ × 7½. (London: H.M. Stationery Office, 1928.) Price 1s.

La Nuez "Carya," "Encarcelada" o "Pecana." *Bolet. Mens., Dep. Econ. y Estad., Sec. de Agric. y Fomento, Mexico* (1928, No. 22, pp. 70-81).

Bye Products of the Pineapple Canning Industry. By V. R. Greenstreet and Gunn Lay Teik. *Malayan Agric. Journ.* (1928, 16, 8-13).

Experiments for the Control of the European Red Mite and other Fruit-Tree Mites. By E. J. Newcomer and M. A. Yothers. *Tech. Bull. No. 25, U.S. Dept. Agric.* Pp. 34, 9 × 5½. (Washington, D.C.: Government Printing Office, 1927.) Price 10 cents.

Fruit-rot Disease of Cultivated Cucurbitaceæ caused by *Pythium aphanidermatum* (Eds.) Fitz. By M. Mitra and L. S. Subramaniam. *Mem. Dept. Agric., India, Bot. Ser.* (1928, 15, 79-84).

Commonwealth of Australia. Tariff Board. Fruit Essences. Report and Recommendation. Pp. 37, 13½ × 8. (Canberra: Government Printer, 1927.) Price 1s. 6d.

#### *Fodders and Forage Crops*

Subterranean Clover (*Trifolium subterraneum* L.). By A. B. Adams, W. M. Carne, and C. A. Gardner. *Journ. Dept. Agric., W. Australia* (1927, 4, 524-530).

Clover Anthracnose caused by *Colletotrichum Trifolii*. By J. Monteith, Jr., *Tech. Bull. No. 28, U.S. Dept. Agric.* Pp. 27, 9 × 5½ (Washington, D.C.: Government Printing Office, 1928.) Price 15 cents.

Bionomics of *Smynturus viridis*, Linn., the South Australian Lucerne Flea. By F. G. Holdaway. *Pamphlet No. 4, Council Sci. and Indust. Res., Australia*. Pp. 23, 9½ × 6. (Melbourne: Government Printer, 1927.)

Successful Cowpea Production. By M. Edelman and W. S. Hall. *Farming in South Africa* (1927, 2, 466-468).

Soya Bean as an alternative Summer Legume. *Farming in South Africa* (1927, 2, 497-498).

Sorgo Silage, Sorgo Fodder, and Cottonseed Hulls as Roughages in Rations for Fattening Calves in the Southwest. By W. H. Black, J. M. Jones, and F. E. Keating. *Tech. Bull. No. 43, U.S. Dept. Agric.* Pp. 24, 9 × 5½. (Washington, D.C.: Government Printing Office, 1928.)

Silage Investigations. By G. S. Robertson, F. Dickinson, and J. Houston. Part I.—Silage and Roots as Farm Crops. *Journ. Ministry Agric., N. Ireland* (1927, 1, 70-104).

Feeding Tests with Stinkwort (*Inula graveolens*). By H. R. Seddon and H. R. Carne. *Vet. Res. Rept. No. 3, Sci. Bull. No. 29, Dept. Agric., N.S.W.*, pp. 46-47. (Sydney: Government Printer, 1927.)

Feeding Tests with Mexican Poppy (*Argemone mexicana*). By H. R. Seddon and H. R. Carne. *Vet. Res. Rept. No. 3, Sci. Bull. No. 29, Dept. Agric., N.S.W.*, pp. 48-50. (Sydney: Government Printer, 1927.)

The Use of Poison Baits for Control of Grasshoppers. Report as to Danger for Stock. By H. R. Seddon. *Vet. Res. Rept. No. 3, Sci. Bull. No. 29, Dept. Agric., N.S.W.*, pp. 51-53 (Sydney: Government Printer, 1927); and *Agric. Gaz., N.S.W.* (1928, 39, 64-66).

Wild Tobaccos (*Nicotiana trigonophylla* Dunal and *Nicotiana attenuata* Torrey) as Stock-Poisoning Plants. By C. D. Marsh, A. B. Clawson and G. C. Roe. *Tech. Bull. No. 22, U.S., Dept. Agric.* Pp. 23, 9½ × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 10 cents.

### *Oils and Oil Seeds*

The Fish Oil Industries. Describing the Production and Utilization of Fish and Marine Animal Oils. By F. H. Meisnest. *Journ. Oil and Fat Indust.* (1928, 5, 33-45. *cont.*).

The Pacific Coast Oil Industry. History, Evolution and Progress of the Vegetable and Fish Oil Trades. By P. W. Tompkins. *Journ. Oil and Fat Indust.* (1928, 5, 48-57).

Report of the Linseed Oil Committee instituted by the Association of Varnish- and Paint Manufacturers and Merchants in the Netherlands, about Raw Linseed Oil. Pp. 18, 9 × 6. (Amsterdam: Vereeniging van Vernis- en Verffabrikanten en Handelaren in Nederland, 1927.)

Report on the Oil Palm Industry in British West Africa. By F. M. Dyke. Pp. 16, 13 × 8½. (Lagos: Government Printer, 1927.)

Notes on a Visit to the Oil Palm Plantations of Sumatra and Malaya. By H. B. Waters. *Sixth Ann. Bull., Agric. Dept., Nigeria*, 1927, pp. 78-121.

Institut Colonial de Marseille. Mémoires et Rapports sur les Matières Grasses. Tome III. Le Palmier à Huile. Pp. 306, 11 × 7½. (Marseille: Institut Colonial, 1928.) [Reprints of papers from *Bulletin des Matières Grasses*, 1922 to 1927.]

Observations on Oil Palms [Artificial Pollination]. By J. D. Marsh. *Malayan Agric. Journ.* (1928, 16, 20-28).

The Striped Blister Beetle on Soy Beans. By J. W. Ingram. *Leaflet No. 12, U.S. Dept. Agric.* Pp. 5, 9½ × 5½. (Washington, D.C.: Government Printing Office, 1927.)

Tung Oil: A review of the possibilities of production within the British Empire, with a complete bibliography of the literature relating to Tung Oil from 1917 to 1927, excluding patents. By L. A. Jordan. *Tech. Paper No. 1, Res. Assoc. of British Paint, Colour and Varnish Manuf.* Pp. 40, 8½ × 5½. (Teddington, Middlesex: Paint Research Station, 1927.)

### *Essential Oils*

Methods of Extracting Volatile Oils from Plant Material and the Production of such Oils in the United States. By A. F. Sievers. *Tech. Bull. No. 16, U.S. Dept. Agric.* Pp. 35, 9 × 6. (Washington: Superintendent, Government Printing Office, 1928.) Price 10 cents.

L'Essence de Bergamotte. By C. Chalot. *Agron. Col.* (1928, 17, 11-13).

Le piantagioni d'Eucalipto in Eritrea e la loro industrializzazione per la produzione di essenze. By P. Rovesti. *Agricolt. Col.* (1928, 22, 9-18).

Le Patchouli. By C. Chalot. *Parf. Moderne* (1928, 21, 54-55).

Le Patchouli aux Seychelles. *Bull. No. 8, 1927, Dept. de l'Agric. et de la Pêche, Seychelles*, pp. 2-3.

The Production of Essential Oils from Irish-grown Plants. Part II. The Cultivation of *Mentha piperita*, and further Experiments on the Winning of Lavender Oil. By J. Reilly and C. Boyle. *Econ. Proc., Royal Dublin Soc.* (1927, 2, 285-291).

The Production of Essential Oils from Irish-grown Plants. Part III. Oil of Peppermint. By J. Reilly and J. Taylor. *Econ. Proc., Royal Dublin Soc.* (1927, 2, 292-297).

Commonwealth of Australia Tariff Board. Peppermint Oil, Application for Bounty. Report and Recommendation. *Parliamentary Paper No. 188, 1926-27*. Pp. 8, 13 × 8½. (Canberra: Government Printer, 1927.) Price 6d.

The Production of Essential Oils from Irish-grown Plants. Part IV. Note on Oil of Camomile. By J. Reilly and P. J. Drumm. *Econ. Proc., Royal Dublin Soc.* (1927, 2, 298-301).

Sandalwood. Notes on the Natural and Artificial Regeneration of the West Australian Sandalwood. By H. R. Gray. *Australian For. Journ.* (1927, 10, 298-306; 322-325).

### Fibres

Les Agaves comme producteurs de fibres et d'alcool. By A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 105-116).

Papers on the Subject of the Accra Sisal Plantation. *Sessional Paper XIX—1927-28*. Pp. 69, 13 × 8½. (Accra: Government Printer, 1927.) Price 3s.

La culture du Sisal en Afrique Occidentale française. By A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 176-189).

Broomcorn Experiments at the United States Dryland Field Station, Woodward, Oklahoma. By J. B. Sieglinger. *Tech. Bull. No. 51, U.S. Dept. Agric.* Pp. 32, 9 × 5½. (Washington, D.C.: Government Printing Office, 1928.)

An Investigation into the Shortening of the Period of Steeping Coir Husks by Boiling in Water and the Possibility of the Utilization of the Extract in Tanning. By R. L. Datta, B. B. Dhavale, and Manmatho Nath Basu. *Bull. No. 32, Dept. Industries, Govt. of Bengal*. Pp. 3, 9½ × 6½. (Calcutta: Government Press, 1928.) Gratis.

Canhamo Brasileiro (*Hibiscus ferrox* Hooker, var.?). By Gustavo Dutra. *Bol. da Ministerio Agric., Indust., e Commercio, Brasil* (1928, 17, 55-71).

De Rotan van Celebes. By C. van der Koppel (with a summary in English). *Tectona* (1928, 21, 61-93).

### Cotton

Reports Received from Experiment Stations of the Empire Cotton Growing Corporation, 1926-1927. Pp. 251, 9½ × 6. (London: Empire Cotton Growing Corporation, 1928.) Price 2s. 6d.

Sea Island Cotton. The West Indian Commissioner of Agriculture's Report. *W.I. Comm. Circ.* (1928, 43, 72-73, 92-93, 112-113, 132-134).

Studies in Khandesh Cotton, Part I. By S. H. Prayag. *Mem. Dept. Agric., India, Bot. Series* (1927, 15, pp. 1-49).

A Critical Comparison of the Factors inhibiting the Development of Three Species of Cotton in Southern Nigeria. By F. D. Golding, O. B. Lean, and T. Laycock. *Sixth Ann. Bull., Agric. Dept., Nigeria*, 1927, pp. 5-69.

Cotton Growing in Southern Africa and the Rhodesias. Report on a Tour undertaken in Southern and Central Africa by the Director of the Empire Cotton Growing Corporation, J. S. Addison and H. C. Jefferys, April-June, 1927. Pp. 30, 9½ × 6. (London: Empire Cotton Growing Corporation, 1927.) Price 2s. post free.

Papers on Cotton Research in the Sudan read at a meeting held in the Gordon College, January 14, 1927. (1) Cotton Growing at the Gezira Research Farm, with a brief account of some of the Experimental Plots. By V. P. Walley, pp. 1-14. (2) Recent Studies in Plant Physiology and Pathology. By R. E. Massey, pp. 15-34. (3) On the Study of Parasitic Insects, and their Economic Importance in the Sudan. By H. B. Johnston, pp. 35-44. (4) An Account of

some Moisture Investigations carried out at the Gezira Research Farm. By H. Greene, pp. 45-59. (Khartoum: Wellcome Tropical Research Laboratories, 1927.)

The Perennial Cultivation of Cotton with Special Reference to the Cultivation of Ratoons in Egypt. By J. Templeton. *Bull. No. 75, Tech. and Sci. Serv., Min. Agric., Egypt.* Pp. 81,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Cairo: Government Publications Office, 1928.) Price P.T. 5.

Le Coton dans l'Uele (Congo Belge). By E. Dejong. *Bull. Agric. Congo Belge* (1927, 18, 451-536).

Factors affecting the Price of Cotton. By B. B. Smith. *Tech. Bull. No. 50, U.S. Dept. Agric.* Pp. 75,  $9 \times 5\frac{1}{2}$ . (Washington, D.C.: Government Printing Office, 1928.) Price 15 cents.

Comparative Observations on the Pests of Cotton at Ilorin, Northern Nigeria. By O. B. Lean. *Sixth Ann. Bull., Agric. Dept., Nigeria*, 1927, pp. 127-143.

Notes on the Bionomics of Cotton Stainers (*Dysdercus*) in Nigeria. By F. D. Golding. *Bull. Entom. Res.* (1928, 18, 319-334).

The Use of Hydrocyanic Acid Gas for the Fumigation of American Cotton on Import into India. Experiments on its Lethal Power for the Mexican Boll-Weevil (*Anthonomus grandis*), and for the Grain-Weevil (*Sitophilus oryzae*); on the Extent to which it is absorbed by Cotton and Jute respectively; and on a Practical Method for Satisfactory Fumigation on a Large Scale. By A. J. Turner and D. L. Sen. *Mem. Dept. Agric., India, Entom. Ser.* (1928, 10, No. 5, pp. 1-166).

On the Incidence of Leaf Curl of Cotton in Southern Nigeria. By C. J. Lewin. *Sixth Ann. Bull., Agric. Dept., Nigeria*, 1927, pp. 70-77.

Cotton Wilt: a Pathological and Physiological Investigation. By D. C. Neal. *Annals, Missouri Bot. Garden* (1927, 14, 359-424).

On the Relation of Soil Temperature to Angular Leaf-Spot of Cotton. By R. E. Massey. Pp. 11,  $9\frac{1}{2} \times 6\frac{1}{2}$ . Reprint from *Annals of Botany* (1927, 163, 497-507).

#### *Paper-making Materials*

Complément au Plan d'Etudes sur les Plantes et Matières Premières Coloniales propres à la Fabrication du Papier (*cont.*). By F. Heim de Balsac and A. Deforge. *Bull. Ag. Gén. des Col.* (1927, 20, 1454-1458).

Die zukünftige Rohstoffversorgung der Papierindustrie und die Hölzer des westafrikanischen Urwaldes. By R. Lorenz. *Tropenpflanzer* (1928, 81, 83-97).

La Balle de Riz en Papeterie. By L. Vidal and M. Aribert. (Avant-propos by E. Prudhomme.) *Agron. Col.* (1928, 17, 41-49).

Valeur Papetière de la Filasse d' "Okon" (*Triumfetta cordifolia* A. Rich.) du Cameroun. By F. Heim de Balsac, A. Deforge, G. S. Dagaud, J. Maheu and H. Heim de Balsac. *Bull. Ag. Gén. des Col.* (1927, 20, 1447-1453).

Commonwealth of Australia. Tariff Board. Strawpaper. Report and Recommendation. Pp. 6,  $13 \times 8\frac{1}{2}$ . (Canberra: Government Printer, 1927.) Price 3d.

#### *Rubber.*

Nineteenth Report of the Council of the Rubber Growers' Association (Incorporated) and Statement of Accounts for Year ended 31st December, 1927. Pp. 46,  $9\frac{1}{2} \times 6$ . (London: Rubber Growers' Association, Inc., 1928.)

Statistics relating to the Rubber Industry. Pp. 23,  $9\frac{1}{2} \times 6$ . (London: Rubber Growers' Association, Inc. 1928.)

Rubber in the Netherlands Indies. By A. G. N. Swart. *Asiatic Rev.* (1928, 24, 205-211).

**Eenkele Beschouwingen over Economie in het Rubberbedrijf.** (Considerations on Economy in the Rubber Industry.) By A. W. K. de Jong. *Med. Alg. Proefsta., A.V.R.O.S., Rubberserie No. 60.* Pp. 43,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Batavia: Drukkerij Ruygrok & Co., 1928.) Reprint from *Archief voor de Rubbercultuur* (1928, 12, 155-197).

**Proeftappingen bij Hevea-Oculaties en Zaaillingen op de Onderneming Boekit Maradja.** (Experimental Tapping on Hevea Buddings and Seedlings on Boekit Maradja Estate.) By H. J. V. S. Holder and Dr. C. Heusser. *Med., Alg. Proefsta., A.V.R.O.S., Rubberserie No. 58.* Pp. 24,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Batavia: Drukkerij Ruygrok & Co., 1928.) [In Dutch and English.]

**Proeftappingen bij Hevea Oculaties, IV.** (Experimental Tappings on Hevea Buddings, IV.) By Dr. C. Heusser. *Med. Alg. Proefsta., A.V.R.O.S., Rubberserie No. 59.* Pp. 11,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Batavia: Drukkerij Ruygrok & Co., 1928.) [In Dutch and English.]

**Iets over de Samenstelling van Balata-Melk uit Suriname.** By W. Spoon. *Berichten No. 33, van de Afdel. Handelsmuseum van de Kon. Vereen. Kol. Instituut.* Pp.  $8\frac{1}{2} \times 5\frac{1}{2}$ . (Amsterdam: Koloniaal Instituut, 1927.) Price Fl. 0.40. Reprinted from *De Indische Mercuur* of 30 November, 1927.

**Jelutong.** By C. D. V. Georgi. *Malayan Agric. Journ.* (1927, 15, 400-407).

#### Tobacco

**Commonwealth of Australia. Tariff Board. Tobacco Industry.** Application for Reduction of Excise Duty or Bounty. Report and Recommendation. Pp. 28,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Canberra: Government Printer, 1927.) Price 1s. 3d.

**Clasificación del Tabaco Portorriquañó para Tripa.** By F. H. Bunker. *Rev. Agric. de Puerto Rico* (1928, 11, 90-92).

**Tobacco Pests of Rhodesia.** Part II. By R. W. Jack. *Rhodesia Agric. Journ.* (1928, 25, 13-25).

**Mosaic Disease of Tobacco.** By J. C. F. Hopkins. *Rhod. Agric. Journ.* (1928, 25, 188-194).

**Wildfire and Angular Spot of Tobacco.** By J. C. F. Hopkins. *Rhod. Agric. Journ.* (1928, 25, 139-143).

**Wildfire in Tobacco.** Results of Investigations into the Control of the Disease. *Farming in South Africa* (1927, 2, 507-509).

#### Drugs

**The Papaya.** By M. R. Siddaramaiya. *Pamphlet No. 1, Pioneer Horticult. Institute.* Pp. 18,  $8 \times 5\frac{1}{2}$ . (Secunderabad, Hyderabad: Pioneer Horticultural Institute, 1928.) Price As. 6.

**Administration Report of the Government Cinchona Department, Madras, 1926-27.** G. O. No. 126, 24th January, 1928. Pp. 34,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Madras: Government of Madras Development Department, 1928.)

**Essais d'acclimatation de l'Arbre à Quinquina en Indochine. Deuxième Note.** By MM. Lambert and A. J. E. Yersin. *Rev. Bot. Appl. et d'Agric. Col.* (1927, 7, 809-816).

**Le Rôle des Engrais dans l'Acclimatation du Quinquina en Indochine.** By F. Main. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 23-28).

#### Miscellaneous Agricultural Products

**Final Observations on the Nipah Palm as a Source of Alcohol.** By J. H. Dennett. *Malayan Agric. Journ.* (1927, 15, 420-432).

**Alcohol Fuel and the Nipah Palm.** A Popular Outline. By J. H. Dennett. *Malayan Agric. Journ.* (1927, 15, 433-445).

**The Downy Mildew of the Hop in 1927.** By E. S. Salmon and W. M. Ware. *Journ. Ministry Agric.* (1928, **34**, 1093-1099).

#### Livestock

**Annual Report of the Veterinary Department, Northern Rhodesia, 1926.** Pp. 30,  $12\frac{1}{2} \times 8$ . (Livingstone: Veterinary Department, 1928.) Mimeographed copy.

**Annual Report of the Department of Veterinary Science and Animal Husbandry, Tanganyika Territory, 1926.** Pp. 68,  $13 \times 8\frac{1}{2}$ . (London: Crown Agents for the Colonies, 1928.) Price 5s.

**Organisation et exploitation d'un élevage au Congo Belge.** By E. Leprieux. II. Les élevages de petit bétail. Première partie—Les moutons. *Bull. Agric. Congo Belge* (1927, **18**, 311-375; *cont.*).

**Report on Dr. Serge Voronoff's Experiments on the Improvement of Livestock.** By F. H. A. Marshall, F. A. E. Crew, A. Walton and W. C. Miller. Pp. 24,  $9\frac{1}{2} \times 6$ . (London: H.M. Stationery Office, 1928.) Price 9d.

**Breeds of Indian Cattle. III. The Murra Buffalo.** By W. Smith. *Journ. Centr. Bur. Anim. Husbandry and Dairying, India* (1928, **1**, 153-162).

**Costs and Methods of Fattening Beef Cattle in the Corn Belt 1919-1923.** By R. H. Wilcox, R. D. Jennings and G. W. Collier. *Tech. Bull. No. 23, U.S. Dept. Agric.* Pp. 114,  $9 \times 6$ . (Washington, D.C.: Government Printing Office, 1927.) Price 20 cents.

**Pure-bred Dairy-Sire Introduction.** By W. E. Wintermeyer. *Circ. No. 6, U.S. Dept. Agric.* Pp. 24,  $9\frac{1}{2} \times 5\frac{1}{2}$ . (Washington, D.C.: Government Printing Office, 1927.) Price 10 cents.

**Breeding for Milk.** By P. J. v. d. H. Schreuder. *Bull. 27, Dept. Agric., Un. S. Africa.* Pp. 35,  $9\frac{1}{2} \times 6$ . (Pretoria: Editor of Publications, Department of Agriculture, 1927.) Price 3d.

**Notes on Sheep Breeding, with Special Reference to South India.** By R. C. Woodford. *Journ. Text. Inst.* (1928, **19**, T59-65).

**Sheep Breeding as a Side Industry in India.** By the Department of Agriculture, Madras. *Journ. Text. Inst.* (1928, **19**, T65-72).

**The Prospective Development of Peru as a Sheep-breeding and Wool-growing Country.** By A. F. Barker. Pp. 174,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (Leeds: Jowett and Sowry, Ltd., 1927.)

**Liver Fluke Disease in Australia: its Treatment and Prevention.** By I. Clunies Ross. *Pamphlet No. 5, Council Sci. and Indust. Res., Australia.* Pp. 23,  $9\frac{1}{2} \times 6$ . (Melbourne: Government Printer, 1928.)

**Pig-Production and Results of Feeding Trials.** By M. J. Scott. *Bull. No. 2, Dept. Animal Husbandry, Canterbury Agric. Coll., Dept. Sci. and Indust. Res., New Zealand.* Pp. 28,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Wellington: Government Printer, 1928.)

**Swine Husbandry in Central Alberta. Results from Thirteen Years of Experiment at the Dominion Experimental Station, Lacombe, Alberta.** By F. H. Reed and L. T. Chapman. *Bull. No. 73, New Series, Dept. Agric., Canada.* Pp. 32,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Ottawa: King's Printer, 1927.)

#### FORESTRY

##### General

**Progress Report of Forest Research in India for the Year 1926-27.** Pp. 191,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Calcutta: Government of India Central Publication Branch, 1928.) Price Rs.4 or 6s. 9d.

**Annual Return of Statistics relating to Forest Administration in British India for the Year 1925-26.** Pp. 31,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Calcutta: Government of India Central Publication Branch, 1927.) Price Rs.2 (3s. 6d.).



Annual Progress Report on Forest Administration in the Presidency of Bengal for the Year 1926-27. Pp. 50,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Calcutta: Bengal Secretariat Book Depot, 1928.) Price Rs. 4 (6s. 9d.).

Annual Report on Working Plans and Silviculture in Burma, 1926-27. Pp. 76,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (Rangoon: Superintendent, Government Printing, 1927.) Price Rs. 2.

Progress Report of the Forest Administration in Coorg for 1926-27. By G. C. Robinson. Pp. 17,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Bangalore: Mysore Residency Press, 1927.) Price Re. 1.

Administration Report of the Forest Department of the Madras Presidency for the Year ending 31st March, 1927. Vol. I. Pp. 177,  $9\frac{1}{2} \times 6$ . Price Rs. 1.6. Vol. II. Pp. 230,  $9\frac{1}{2} \times 6$ . Price Rs. 1.8. (Madras: Superintendent, Government Press, 1928.)

Report of the Forest Committee, Ceylon. Sessional Paper I.—1928. Pp. 111,  $13 \times 8\frac{1}{2}$ . (Colombo: Government Record Office, 1928.) Price Rs. 2.25.

Report on Forest Administration, Kedah, for the Year 1345 (1926-27). Pp. 22,  $13 \times 8$ . (Typewritten copy.)

Forestry in the State of North Borneo. A Statement prepared for the British Empire Forestry Conference, Australia and New Zealand, 1928. By D. D. Wood. Pp. 19,  $13 \times 8$ . (Sandakan, North Borneo, 1927.)

Annual Report of the Department of Forestry, Union of South Africa, for the Year ended 31st March 1927. Pp. 28,  $13 \times 8\frac{1}{2}$ . (Pretoria: Government Printing Office, 1928.) Price 2s.

Report of the Forest Branch of the Department of Lands, British Columbia, for the Year ended December 31st, 1926. Pp. 47,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Victoria, B.C.: King's Printer, 1927.)

Report of the Provisional Forestry Board, Queensland, for the Year ended 30th June, 1927. Pp. 54,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Brisbane: Government Printer, 1927.) Price 2s.

Annual Report, Woods and Forests Department, South Australia, for the Year ended June 30th, 1927. Pp. 10,  $13 \times 8\frac{1}{2}$ . (Adelaide: Government Printer, 1927.)

The Forests of the Colony of Fiji. By J. P. Mead. *Fiji Legislative Council Paper* M.P. 4781/27. Pp. 47,  $13 \times 8\frac{1}{2}$ . (Suva: Government Printer, 1928.)

Forests and Floods. By W. Shepard. *Circ. No. 19, U.S. Dept. Agric.* Pp. 24,  $9 \times 6$ . (Washington, D.C.: Government Printing Office, 1928.)

Experimental Vegetation: A Second Contribution. By J. F. V. Phillips. *Forestry Dept., Un. S. Afr.* Pp. 10,  $9\frac{1}{2} \times 6$ . (Johannesburg: South African Association for the Advancement of Science, 1927.) Reprint from *South African Journ. Sci.* (1927, 24, 259-268.)

Revision des *Acacia* du nord, de l'ouest et du centre africain. By A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 46-52; 123-130; 197-206; cont.).

The Behaviour of *Acacia melanoxylon* R. Br. ("Tasmanian Blackwood") in the Knysna Forests: an Ecological Study. By J. F. V. Phillips. Pp. 13,  $9\frac{1}{2} \times 7\frac{1}{2}$ . Reprint from *Transactions of the Royal Society of South Africa* (16, Part I, 31-43).

*Ekebergia capensis* Sparrm. ("Essenhout") in the Knysna Region: A Preliminary Ecological Note. By J. F. V. Phillips. *Forestry Dept., Un. S. Afr.* Pp. 9,  $9\frac{1}{2} \times 6$ . (Johannesburg: South African Association for the Advancement of Science, 1927.) Reprint from *South African Journ. Sci.* (1927, 24, 216-224).

*Faurea McNaughtonii* Phill. ("Terblanz"): A Note on its Ecology and Distribution. By J. Phillips. Pp. 20,  $9\frac{1}{2} \times 7\frac{1}{2}$ . Reprint from *Transactions of the Royal Society of South Africa* (14, Part IV, 317-336).

Dendrographic Experiments: *Ocotea bullata* E. Mey. ("Stink-

wood"). By J. F. V. Phillips. *Forestry Dept., Un. S. Afr.* Pp. 17,  $9\frac{1}{2} \times 6$ . (Johannesburg: South African Association for the Advancement of Science, 1927.) Reprint from *South African Journ. Sci.* (1927, 24, 227-243).

Notes on Artificial Extraction of Seeds from Cones of *Pinus longifolia* and *Pinus patula*. By C. C. Robertson. *Forestry Dept., Un. S. Afr.* Pp. 8,  $9\frac{1}{2} \times 6$ . (Johannesburg: South Africa Association for the Advancement of Science, 1927.) Reprint from *South African Journ. Sci.* (1927, 24, 320-327).

Western Yellow Pine (*Pinus ponderosa*). *Tree Pamphlet No. 13, Forest Service, Dept. Interior, Canada*. Pp. 6,  $8\frac{1}{2} \times 6$ . (Ottawa: King's Printer, 1927.)

Volumes of single Trees and Volumes and Number of Trees per Acre from Data collected in Teak (*Tectona grandis*) Plantations in Burma, also Volumes of sample Trees of *Dipterocarpus tuberculatus*, *Terminalia tomentosa*, and *Terminalia pyrifolia*. By G. S. Shirley. *Burma Forest Bull. No. 17, Silvicult. Ser. No. 13*. Pp. 14,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Rangoon: Superintendent, Government Printing, 1928.)

Forest Insects and Timber Borers. By W. W. Froggatt. Pp. 107,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (Sydney: Government Printer, 1927.)

Douglas Fir Leaf-cast Disease (*Rhabdochline Pseudotsugae* Syd.). *Leaflet No. 18, Forestry Commission*. Pp. 3,  $9\frac{1}{2} \times 6$ . (London: Forestry Commission, 1927.) Gratis.

### Timbers

Report of the Indian Tariff Board regarding the Grant of Protection to the Plywood and Tea Chest Industry. Pp. 61,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Calcutta: Government of India Central Publication Branch, 1927.) Price As.12 (1s. 3d.).

Indian Tariff Board. Evidence Recorded during Enquiry Regarding the Grant of Protection to the Ply Wood and Tea Chest Industry. Pp. 357,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Calcutta: Government of India Central Publication Branch, 1928.) Price Rs.3-12 (6s. 6d.).

Commonwealth of Australia Tariff Board. Timber. Report and Recommendation. *Parliamentary Paper No. 167, 1926-27*. Pp. 30,  $13 \times 8\frac{1}{2}$ . (Canberra: Government Printer, 1927.) Price 1s. 3d.

Commonwealth of Australia Tariff Board. Tool Handles of Wood. Report and Recommendation. *Parliamentary Paper No. 196, 1926-27*. Pp. 8,  $13 \times 8\frac{1}{2}$ . (Canberra: Government Printer, 1927.) Price 3d.

Notes on the Characteristics and Minute Structure of Thirty Woods Indigenous to South Africa. By M. H. Scott. *Bull. No. 20, Forest Dept., Un. S. Africa*. Pp. 20,  $9\frac{1}{2} \times 6$ . (Johannesburg: South African Association for the Advancement of Science, 1927.) Reprint from the *South African Journ. Sci.* (1927, 24, 298-317).

American Lumber in Japan. By E. A. Selfridge. *Trade Promotion Series, No. 59, Bur. For. and Dom. Comm., U.S. Dept. Comm.* Pp. 49,  $9\frac{1}{2} \times 5\frac{1}{2}$ . (Washington: Government Printing Office, 1928.) Price 15 cents.

Études Systématiques des Bois du Katanga. By G. Delevoy. Mesures et Essais effectués au Laboratoire des Matériaux de l'Université libre de Bruxelles, par MM D. Dustin et D. Rosenthal. Publication du Comité Spécial du Katanga. Fasc. I, pp. 24; Fasc. II, pp. 37; Fasc. III, pp. 36,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (Brussels: J. Lebegue & Cie, 1928.)

A propos de l'Acajou blanc (*Khaya* sp.) de la Côte d'Ivoire. By A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 207-211).

Note sur l'*Erica arborea* et sur l'emploi de ses souches dans la fabrication des pipes. By A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1927, 7, 640-756; 739-752.)

Okoumé (*Aucoumea Klaineana* Pierre). By MM. Bertin, Aug. Chevalier and others. *Actes et Comptes-Rendus de l'Assoc. Colonies—Sciences* (1927, 3, 245–261; 1928, 4, 13–21) [issued with *Rev. Bot. Appl. et d'Agric. Col.*, Dec. 1927 and Jan. 1928].

The Naming of Woods. By F. H. F. Swain. Pp. 8, 11 × 6½ (Rockhampton, Queensland: Provisional Forestry Board).

Beetles injurious to Timber. By J. W. Munro. *Bull. No. 9, Forestry Commission*. Pp. 29, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 1s. 3d.

The Western Cedar Pole Borer or Powder Worm. By H. E. Burke. *Tech. Bull. No. 48, U.S. Dept. Agric.* Pp. 16, 9 × 6. (Washington, D.C.: Government Printing Office, 1928.) Price 5 cents.

The Principles of Kiln-seasoning of Timber. Part I: Types of Commercial Kilns in Use. By S. T. C. Stillwell. *Spec. Rep. No. 2, For. Prod. Res., Dept. Sci. and Indust. Res.* Pp. 11, 9½ × 7½. (London: H.M. Stationery Office, 1928.) Price 9d.

#### Gums and Resins

Chicle (*Achras Sapota* L.). *Bol. Mens., Dep. Econ. y Estad., Sec. de Agric. y Fomento, Mexico* (1928, No. 22, pp. 82–92).

#### Tanning Materials

The Common Oaks and Chestnuts of Maymyo and Kalaw. By C. W. Scott and C. E. Parkinson. *Burma For. Bull. No. 19, Bot. Ser. No. 1*. Pp. 16 + 24 plates, 9½ × 6½. (Rangoon: Superintendent Government Printing, 1928.)

Procédés de culture et d'exploitation de l'Acacia à tanin à Madagascar. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 139–144).

Contribution à l'Étude des Écorces Tannifères de Madagascar (cont.). By F. Heim de Balsac, A. Deforge, J. Maheu and H. Heim de Balsac. III. Écorce de "Rotra" (*Eugenia* spp.). IV.—Écorce de "Filao" (*Casuarina equisetifolia* L.). *Bull. Ag. Gén. des Col.* (1927, 20, 1164–1174; 1431–1447).

## NOTICES OF RECENT LITERATURE

*Books for review should be addressed to "The Editor, Bulletin of the Imperial Institute, South Kensington, London, S.W.7."*

THE DEVELOPMENT OF INDIAN AGRICULTURE. By Albert Howard, C.I.E., M.A., and Gabrielle L. C. Howard, M.A. Pp. 98, 7½ × 4½. (London: Humphrey Milford, 1927.) Price 3s. 6d.

This work, which forms Volume VIII of the *India of To-day* Series, is a striking contribution to the study of India's most pressing need, namely the improvement of native agriculture. The authors point out the great progress already made, based on the scientific study of the problem, but emphasise the importance of welding together into a single efficient agency the various independent efforts at present working. The Experiment Stations can devise improved methods of cultivation and raise new and

better varieties, but there still remains the human factor which hinders the application of these advances. The authors consider that a great advantage would accrue if the control of the various agencies which deal with rural India were taken over from the State by a non-official body. They suggest the creation in each Province of a Development Board, on which the Legislature, the Executive, the local notables and the most able of the workers could be represented, and claim that such a body would not only maintain direction but would also provide that steady driving power which is essential for real and steady progress.

Closely bound up with the question of the application of science to the improvement of Indian agriculture is that of the education of the people. Progress must necessarily be slow when the men and women, on whom all developments in Indian agriculture depend, can neither read nor write and so cannot be reached by any form of literature. This subject is ably dealt with by the authors, who discuss the education both of the adult and of the child. As regards the former, they favour some such system as that adopted in the Southern States of America, where it was decided that it is better to co-operate with the people and to teach them how to educate themselves than to foist upon them a programme of education from outside.

This book should be read by all interested in the progress of India. It not only gives an excellent summary of the present position of Indian agriculture, but contains many fruitful suggestions for its improvement ; numerous references to literature are given from which more detailed particulars can be obtained.

**BRITISH FARMERS IN DENMARK.** By J. R. Bond and other Members of the Mission of Inquiry into Denmark's Agricultural Methods. Reprinted from *The Daily Telegraph*. Pp. xi + 82, 8½ × 5½. (London : Ernest Benn Limited, 1928.) Price 1s. 6d.

The reports in this pamphlet were prepared for the benefit of farmers in the United Kingdom, who, it is considered by the authors, should take careful note of the organisation of agriculture in Denmark with a view to the possible adoption of certain of the methods which have been found specially advantageous. The reports, which cover such matters as hours and wages, crop production, the management of cattle, agricultural education and research, and co-operative marketing methods, should prove of considerable interest to those concerned with the problems dealt with.

**THE USEFUL AND ORNAMENTAL PLANTS OF TRINIDAD AND TOBAGO.** By W. G. Freeman, B.Sc., A.R.C.S., F.L.S., and R. O. Williams. Memoirs of the Department of Agriculture, Trinidad and Tobago, Number Four. Pp. 198,  $9\frac{1}{2} \times 6$ . (Trinidad: The Government Printer, 1927.) Price 2s. 6d.

In preparing this memoir the object of the authors has been to bring together in a concise form popular information regarding the useful and ornamental plants, native and introduced, occurring in Trinidad and Tobago. They have accomplished this task with success, and have produced a handbook that will also be read with interest and profit in tropical countries other than the two islands mentioned. The information given is of a kind that will be especially welcome to botanists and others desiring an introduction to the commoner plants they are likely to meet in the profusion of vegetation which is so bewildering to the newcomer to the tropics or to the resident taking up the study for the first time. The plants are dealt with in alphabetical order of their botanical and popular names. The botanical family is stated and is followed by the common names of the species. The description is given in non-technical language and, while popular in form, furnishes the essential information regarding the botanical characters of the plant, its uses and cultural details where appropriate. Special reference may be made to the usefulness of the longer articles, e.g. those dealing with ferns, grasses, *Begonia* spp. and orchids; a general account of the palms, supplementing the present cross references to the species described, would have been a useful addition. Throughout the work there is abundant evidence that the particulars recorded are in large measure the result of personal observations of the authors, who have wide knowledge and experience of tropical plant life. The book concludes with lists of "useful" plants classified by the nature of their products, and of ornamental species grouped as flowering trees, shade trees, climbers, etc. The description of a botanical grouping of the plants dealt with in the book as a "Botanical Key" raises hopes of a method of identification which unfortunately are not realised.

**SUGAR BEET AND BEET SUGAR.** By R. N. Dowling. With a Foreword by Sir Daniel Hall, K.C.B., F.R.S., LL.D., D.Sc. Pp. x + 277,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: Ernest Benn, Limited, 1928.) Price 15s.

This may be regarded as an authoritative work on beet and beet sugar, as it has been written by one who knows his subject thoroughly from both theoretical and

practical standpoints. In the foreword to the book Sir Daniel Hall says : " Mr. Dowling has been associated with modern sugar beet growing ever since it received a large scale trial in this country, long before it became a commercial crop. His experience has been wide, his enthusiasm has made him untiring and searching in his enquiries, behind both he has the equipment and the outlook of the practical farmer. His book stands alone and merits the closest consideration from every grower of sugar beet."

The subject is treated in a clear and simple manner so as to be intelligible to all classes of readers, and is well illustrated. An interesting account is given of the history and progress of the sugar beet industry, and of its present position in Great Britain and its rapid growth in the United States. The cultivation of the beet is fully dealt with in all its phases. The last chapter gives a brief description of the beet sugar factory and the production of the sugar.

CITRUS PRODUCTS. Part II. By James B. McNair. Pp. x + 180, 9½ × 6½. *Field Museum of Natural History Publication* 245 ; *Botanical Series Vol. VI, No. 2.* (Chicago : Field Museum of Natural History, 1927.)

This is the second part of a publication the first part of which was reviewed in this BULLETIN, 1927, 25, 196. As previously indicated, the present volume is concerned with the citrus products industry in the different producing countries of the world. The first chapter relates generally to production, marketing, prices and the economics of the industry, subsequent chapters dealing with the industry in particular countries. Methods of manufacture, packing and shipping are described and questions of costs discussed. Useful trade statistics are given in an appendix.

OILS, FATS AND FATTY FOODS : THEIR PRACTICAL EXAMINATION. By E. Richards Bolton, F.I.C., F.C.S., with a chapter on Vitamins by J. C. Drummond, D.Sc., F.I.C. Being a Second Edition of *Fatty Foods* by E. Richards Bolton and Cecil Revis. Pp. xvi + 416, 9½ × 5½. (London : J. and A. Churchill, 1928.) Price 30s.

The excellence of this book, which originally appeared under the title of *Fatty Foods*, has been well maintained in the new edition, the publication of which has been necessitated by the progress that has been made in the use of edible oils and fats during the last fifteen years, principally as an outcome of the war. The general scheme of the work is the same as in the earlier volume, but the matter has been considerably augmented by the inclusion of fresh sections and other portions have been re-written.

One of the new chapters is devoted to a description of the industrial production of vegetable oils and fats, while another deals with the hydrogenation of oils and the analysis, detection, properties and uses of hardened oils. The descriptions of the individual vegetable oils and fats have been arranged according to the Natural Orders to which the different seeds belong and not, as in the previous edition, according to their properties. The list of oils and fats thus described has been greatly extended and includes those which have come into prominence of late years on account of the shortage of oilseeds experienced during the war. The book closes with a chapter on vitamins, entitled "The nutritive value of the edible oils and fats" written by Dr. J. C. Drummond. The volume contains 12 plates and 34 text figures and is furnished with two indexes, one of botanical names and the other general. It can be thoroughly recommended and will be exceedingly useful to the analyst and to all those engaged in the edible oil and fat industry.

MÉMOIRES ET RAPPORTS SUR LES MATIÈRES GRASSES. TOME III : LE PALMIER À HUILE. Pp. 306. 11 × 7½. (Marseilles : Institut Colonial, 1928.)

This volume continues the series of publications issued by the Institut Colonial, Marseilles, on the production and utilisation of oils and fats, particularly those of tropical and sub-tropical origin. The first two volumes of the series reproduced the principal articles on this subject which had appeared in *Le Bulletin des Matières Grasses* up to the year 1922. The new volume, which is devoted entirely to palm oil, contains the more important papers on this subject that have been published in the same *Bulletin* during the years 1922 to 1927. The papers have been grouped together in four chapters under the headings of: The Oil-Palm in West Africa; The Oil-Palm in Equatorial Africa; The Oil-Palm in Malaya; and the Preparation of Palm Oil and Palm Kernels.

COTTON IN SOUTH AND EAST AFRICA. By W. C. Aman. Pp. xxiii + 156, 7½ × 5½. (London : Longmans Green & Co., Ltd. ; Johannesburg : R. L. Esson & Co., Ltd., 1927.) Price 6s.

This work, described on the title page as "An Annual Book of Reference for the Cotton Merchant, Ginner, Planter and Prospective Settler," gives a concise review of the progress, development and statistics of cotton growing in what the author states to be an area embracing some of the most promising of the world's "new" cotton lands.

The countries dealt with comprise the Union of South Africa (including Swaziland), Southern and Northern Rhodesia, Nyasaland, Tanganyika, Kenya and Uganda. In addition to particulars as to the production of cotton in the different regions (statistics of which in most cases are given up to 1925), useful notes are provided on the time of planting and picking, special cultural methods, ginning facilities, marketing, pests and diseases, varieties planted, legislation and other points of interest to growers. The author has had personal experience of the cotton growing industry in the regions dealt with and has received the assistance of Agricultural Officers in the different countries, so that the book may be regarded as an authoritative account of the subject and should be of much value to all interested in cotton growing in South and East Africa.

**THE MANUFACTURE OF ARTIFICIAL SILK WITH SPECIAL REFERENCE TO THE VISCOSE PROCESS.** By E. Wheeler, M.B.E., A.C.G.I., A.I.C. Pp. xv + 150, 8½ × 5½. (London : Chapman and Hall, Ltd., 1928.) Price 12s. 6d.

The rapid developments which have taken place during recent years in the artificial silk industry, the great financial importance it has attained, and the large number of workers now engaged in manufacturing, spinning and weaving the products and in investigating possible improvements in these operations, have led to the formation of a considerable literature. This consists largely of patent specifications and the technical journals now devoted to the industry, especially in Germany and the United States.

The collection of this material into the form of a handbook has already been attempted by more than one author and such books have already been noticed in this BULLETIN. The present work has been issued as the first volume in a series of " Monographs on Applied Chemistry " now being prepared under the editorship of Dr. E. Howard Tripp. The subject is treated in a clear and methodical manner. The history of artificial silk is briefly outlined and full particulars are given regarding the processes of production of the fibre by the viscose, cuprammonium and nitro-cellulose processes. The method of manufacturing artificial silk from cellulose acetate, and a number of miscellaneous processes are also described, including those involving the use of gelatine, zinc chloride, cellulose ethers, casein, and sulpho-cyanides and cellulose. An account is given of the mechanical, chemical and colloid properties of artificial silk, and information is supplied regarding its behaviour towards dye-stuffs and its various uses in the manufacture of hosiery, knitted goods and cloths, and its



employment in combination with cotton, wool and true silk. Reference is also made to the production of miscellaneous artificial fibres, including "staple fibre," synthetic wool, artificial horsehair and artificial straw. In an appendix to the work, particulars are furnished regarding the laboratory methods employed for controlling viscose manufacture, for determining the physical properties of artificial silk and for identifying the different varieties by chemical tests. At the end of each chapter is given a useful list of references to the literature on the subjects with which it deals. The work is copiously illustrated and can be recommended to the attention of chemists, engineers and others interested in the artificial silk industry.

THE INDIAN MATERIA MEDICA. Edited and Published by K. M. Nadkarni, F.S.Sc., L.A. (Lond.), M.C.S. (Paris). Pp. 1450,  $7\frac{3}{4} \times 4\frac{3}{4}$ . (Bombay: The Author, 1927.) Price 18s.

This should prove a useful book of reference on the pharmacology of Indian drugs. The author, who supports the Ayurvedic system of medicine, has been at some pains to collect information regarding indigenous drugs and their applications, and urges the financial saving that would be effected by their use in India in place of imported Western drugs.

COMMERCIAL TIMBER TREES OF THE MALAY PENINSULA. By F. W. Foxworthy. *Malayan Forest Records No. 3*. Pp. 195,  $10\frac{1}{2} \times 7\frac{1}{4}$ . (Conservator of Forests, F.M.S. and S.S., Kuala Lumpur, Federated Malay States, 1927.) Price \$5 or 12s.

This book will prove of great value to forest officers and others concerned with the timber trees and forest resources of the Malay Peninsula and will be widely welcomed as an important addition to the literature of the tropical forest of the East. The chief object of the author has been to provide a handbook of convenient size which could be used for identifying the more important trees of Malaya and would at the same time furnish a summary of the information available regarding each species. So numerous are the tree species of Malaya that it was found necessary to restrict the work to those which can be regarded as commercial timber trees or which are so conspicuous in appearance as to compel attention in the forest. The area occupied by commercial forest in Malaya is estimated at about 30,000 square miles, in addition to which there are considerable regions where the original forest has been destroyed and is now replaced by second growth forest.

Three main classes of forest are recognised : the littoral forests of the beaches and mangrove swamps which produce relatively few timber trees ; the hill forests, occurring at elevations above 2,000 ft. which at present are not of economic importance ; and the lowland forests. The latter comprise the fresh-water swamp forest containing a comparatively small number of species, and also the inland high or rain forest which is made up of a very large number of species and includes most of the commercial timber trees of the country. It is with rain forest, therefore, that the author is chiefly concerned. He points out that, in spite of the complexity of the forests of the country and of the wealth of species they contain, the proportion of species which are of economic importance is small. The position is illustrated in the fact that while the tree species known to occur in the Peninsula number about 2,500 (representing probably not more than 75 per cent. of the total species) the number of trees described by the author amounts to sixty-five, of which probably not more than one-quarter are of outstanding importance.

The book comprises a short introduction giving an account of the main features of the forests of the Malay Peninsula, followed by a " key " to the identification of the species described in the main part of the volume. The key is of a very practical kind and is based largely upon the characters and structure of the outer bark and of the inner bark and sapwood, the occurrence of buttresses, and leaf characters ; these characters are the only ones likely to be available for inspection without felling the trees, reliance being placed on fallen leaves for the examination of leaf characters. In dealing with the tree descriptions the species are grouped in botanical natural families. Particulars are given regarding the alternative names of the tree, its abundance and manner of distribution, followed by a description of the botanical characters in non-technical language. Subsequent sections deal with the commercial products of the species and its silviculture. In the case of the more important species useful information is given regarding other forms likely to be confused with the tree under consideration.

The methods adopted by the author in collecting the information on which the book is based are such as will command confidence in the value of the book. Extensive collections of herbarium material enabled the botanical identity of trees to be established and furnished valuable particulars regarding the distribution of the species. Information as to the relative and actual abundance of the different forms was obtained from special valuation surveys

of over a million acres in different parts of the forest and this work was supplemented by a careful field study of the species themselves. The information available in the records of the Forest Department regarding sylvicultural treatment has been carefully revised and compared with experience in other countries before being incorporated in the present work.

The book is fully illustrated with admirable photographs of the trunk and bark characters and of the foliage, flowers and fruits wherever feasible. There is a useful index and a clear map of the Peninsula.

*Addendum.*—In the *Journal of the Malayan Branch of the Asiatic Society* (1927, Vol. V, Pt. II) F. W. Foxworthy records, under the title of "Tree Names: a Few Changes," the recent alterations in the terminology of certain commercial timber trees of Malaya referred to in the book noticed above. The following are the changes made: Chengal (*Balanocarpus Heimii* King), formerly described as *B. maximus* King; Damar minyak (*Agathis alba* (Lamk.) Foxw.), formerly *Dammara alba* Lamk., etc.; Dedaru (*Urandra corniculata* (Becc.) Foxw.), formerly *Platea corniculata* Becc. etc.; Keladan, now quoted as *Dryobalanops oblongifolia* Dyer; Mulut (*Hopea anomala* (King) n. comb.), formerly *Balanocarpus anomalus* King; Malabira (*Fagraea crenulata* Maing), hitherto incorrectly referred to *F. fastigiata* Bl.; Merbatu (*Parinarium* spp. and *Angelisia splendens* Korth.), formerly *Parinarium nitidum* Hook. f., etc.; Merbau (*Intsia* spp.), the approved names and their principal synonyms being *Intsia Bakeri* Prain (*Afzelia palembanica* Baker), *I. bijuga* (Colebr.) O. Ktze. (*Afzelia bijuga* A. Gray), *I. retusa* (Kurz) O. Ktze. (*Afzelia retusa* Kurz); Mersawa (*Anisoptera* spp.), the commonest species being *A. thurifera* (Blco.) Bl. (*A. glabra* Kurz); Tembusu (*Fagraea* spp.), two common species being *F. fragrans* Roxb. and *F. gigantea* Ridl.

HANDBOOK OF CHEMISTRY AND PHYSICS. A READY-REFERENCE POCKET BOOK OF CHEMICAL AND PHYSICAL DATA. By Charles D. Hodgman, M.S., and Norbert A. Lange, Ph.D. Twelfth Edition. Pp. xi + 1112, 6½ × 4½. (Cleveland, Ohio: Chemical Rubber Publishing Co., 1927.) Price \$5.00.

In this new edition the general features and scheme of arrangement of the former editions have been retained. The aim throughout has been to include in one volume

accurate, reliable and up-to-date information on all branches of chemistry and physics and closely allied sciences which would be likely to find any extended use. Among the contents is to be found tabulated and in a form for easy and quick reference a very large quantity of data dealing with mathematics, general chemistry, the properties of matter, heat, hydrometry and barometry, light, sound, and electricity and magnetism. The present edition has been enlarged by a further 100 pages; many new tables have been added while others have been made more complete and comprehensive. The book contains a vast amount of information on a variety of scientific subjects, presented in a very clear and concise form. It will be found to be a most useful book for reference purposes.

**THE HUMAN HABITAT.** By Ellsworth Huntington. Pp. xii + 293,  $8\frac{1}{2} \times 5\frac{1}{4}$ . (London: Chapman and Hall, Ltd., 1928.) Price 15s.

This is a well-written and attractive work, dealing with the relations between civilisation and physical geography. In the author's words, it is "an attempt to give the layman a true idea of human geography as interpreted by the American school of geographers" and "does not pretend to present the proof of the many conclusions which it sets forth, nor to cover the whole field." This field is undoubtedly very wide, and the work is one of which it is difficult to present an adequate impression in a short notice; it can, however, be stated that the volume is likely to be of considerable value to students of social economics in relation to geographical conditions. Its scope may be indicated by the following selections from the titles of the chapters: The Effect of Geographic Extremes; Lands that are too Cool; The Civilisation of Rice Lands; The Interplay of Climatic and Human Changes; The Contrast between Japan and China; The Civilisation of Europe; America Past and Present. Whatever views may be held regarding certain of the author's conclusions, the work should prove of much interest both to students of geography and to the general reader.

**THE ELEMENTS OF ECONOMIC GEOLOGY.** By J. W. Gregory, D.Sc., F.R.S., M.Inst.M.M. Pp. xv + 312,  $7\frac{1}{2} \times 5$ . (London: Methuen & Co., Ltd., 1928.) Price 10s.

In this book the author has compressed the treatment of Economic Geology within the narrow compass of 296 rather small pages of descriptive matter. The field

covered is large, and the statements necessarily brief and incomplete on such a variety of topics. Part I gives an account of the scope of the subject and the formation of ore deposits, including a statement of the author's view that ores are derived from an ore-zone surrounding the barysphere: "the barysphere is doubtless surrounded by an ore-zone composed of mixed silicates and metallic minerals. The surface of the barysphere is probably irregular and peaks rise from it into the lithosphere and upraise the overlying ore-zone to a level at which they feed the lodes. Magmatic water from the ore-zone rises through the overlying plutonic rocks and carries metals upwards along fractures and fissures."

Part II, consisting of nine chapters (pp. 35-156), deals with ore deposits under the headings of the various metals; part III, of seven chapters (pp. 157-218), with earthy minerals including micas, asbestos, gems, clay, building stones and road metal, cements, soils, fertilisers and salt deposits; part IV with engineering geology, including water supply, coast erosion and defence works, and earthquakes; part V with mineral fuels including coal, mineral oil and oil shale.

The book concludes with three useful indexes (pp. 297-312) of authors, localities and subjects. As a closely condensed and well-written account of the elements of economic geology, it should serve a very useful purpose, especially for students.

**THE CORNISH MINER.** By A. K. Hamilton Jenkin, M.A., B.Litt. (Oxon.). Pp. 351, 8½ × 5½. (London: George Allen and Unwin, Ltd., 1927.) Price 12s. 6d.

This is a fascinating book, for it is written in excellent style, is well illustrated, and traces the history of the Cornish miner from very early days, through many vicissitudes, up to recent years. Many authorities are quoted, and the author is to be congratulated on the careful way in which this historical work has been written.

The reader is told all about the ancient privileges of the tinnerns under the Stannaries, including "bounding"; the ancient streamers are made to live again, and there is a good description of the blowing-houses (primitive furnaces for smelting alluvial tin). The vicissitudes of the eighteenth century are dealt with. During this time, owing to the large output of copper from the Parys mine, Anglesea, many copper mines in Cornwall had to close down, and, owing to the consequent increase in output of Cornish tin, and to the imports of Malacca tin, there was a serious fall in the price of the metal. Unfortunately the price of

corn was very high at that time, and many riots took place in Cornwall among the half-starved miners.

At the beginning of the nineteenth century, there was a great revival, due to the fall in the price of materials and the rise in the price of tin. This prosperous period was marked by the making of roads, railways and heavy machinery, and the erection of smelting works in Cornwall. In the mines there were many improvements, especially as regards drainage, underground transport, hoisting, ventilation and methods of stoping. In the latter part of the nineteenth century there was another big fall in the price of the metal, and many of the Cornish tin mines, as is well known, had to close down. In recent years there has been a distinct revival in tin mining in Cornwall, consequent on the big rise in the price of the metal, so that this book has been published at a most opportune time, and should be read by everyone interested in Cornish mines and the Cornish miner.

**MINING ENGINEERS' HANDBOOK.** Editor-in-Chief, Robert Peele. Second Edition. Pp. xiv + 2523, 7 × 4½. (New York : John Wiley & Sons, Inc. ; London : Chapman and Hall, Ltd., 1927.) Price 50s.

As pointed out in the preface, since the publication, in May, 1918, of the first edition of this book, important changes have taken place in the mining industry, many of which are due to the rapid development of engineering practice, and others to the large increase in the cost of labour. From the latter have inevitably resulted improved methods or improved organisation, and the employment of more and better mechanical appliances.

This encyclopædic work, contributed to by a number of American authors who are authorities on their respective subjects, may be regarded as indispensable to the mining engineer. But the work, containing upwards of 2,500 pages, has become altogether too bulky in one volume. It is also published in two volumes, which is far handier, if more costly. It is to be hoped that in future editions certain sections which are on accessory subjects will be omitted, thereby saving some 500 pages of space. The fact is the mining engineer is usually provided with special works on such subjects. We refer especially to section 1, mineralogy ; section 2, geology and mineral deposits ; section 30, assaying ; and sections 36 to 43 inclusive, on mathematics, hydraulics, thermodynamics, steam engines, etc., mechanical and electrical engineering, and elements of structural design.

The bibliographies at the end of each section are very useful for reference purposes, but, unfortunately, in a good many instances the dates of certain papers or periodicals quoted are not given.

Section 3, on earth excavation, and section 5, on rock excavation, by H. P. Gillette, have been revised and largely re-written by R. T. Dana and A. P. Ackerman; section 9, on boring, by Prof. A. T. Taggart, has been largely re-written by Prof. Robert S. Lewis, especially the pages devoted to rotary drilling for oil and diamond drilling; section 10, on prospecting, development and exploitation of mineral deposits, by James F. McClelland—the most important one in the book for the mining engineer—has been revised and enlarged from 450 to 586 pages. Other sections which have been revised and added to are 12, hoisting, etc., by W. M. Weigel; 13, drainage, by R. V. A. Norris; 15, compressed-air plant, by R. T. Dana; 16, electric power for mine service, by G. R. Wood.

Section 28, which in the first edition was on ore dressing, by Prof. Robert H. Richards, has been confined in the new edition to breaking, crushing and sorting of ores, thereby saving about 50 pages of space. It is written by Prof. Taggart, who has also written section 31, on the testing of ores. Section 33, on gold amalgamation and cyanidation by the late E. L. Dufourcq, has been revised by John V. N. Dorr.

**WIRE ROPES IN MINES: SOME NOTES REGARDING THEIR MANUFACTURE AND USE.** (Safety in Mines Research Board Paper No. 41, H.M. Stationery Office.) Price 1s. net.

The first part of this paper gives an account of the manufacture and properties of wire ropes used in mines, and of the construction of the rope itself. For the information of those who have not specially studied metallurgy, the notes are preceded by a section on the manufacture of steel.

The rest of the paper relates to the selection and use of wire ropes under mining conditions. There are chapters on the factor of safety, the various types of capping, the renewing of the capping, lubrication, the drum, the handling and care of a rope, the examination of ropes in use, and the deterioration of ropes during service. Guide ropes, balance ropes and haulage ropes are considered, as well as winding ropes.

A list is given of the more urgent outstanding problems in regard to which research is in progress. It is stated

in an introductory note that some interesting results have already been obtained and will be published shortly.

**TECHNICAL METHODS OF ORE ANALYSIS FOR CHEMISTS AND COLLEGES.** By Albert H. Low, Sc.D. Tenth Edition, Revised. Pp. xxxiv + 348,  $9 \times 5\frac{1}{4}$ . (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 17s. 6d.

This volume is stated to be a careful revision of the previous edition, with the addition of some new subject matter. Mistakes and typographical errors are said to have been corrected.

The "Remarks to Instructors" have been omitted, and the "Outlines of Methods for Students' Use," which included detailed instructions for 16 analytical determinations, have been replaced by some general "Instructions to Students" on laboratory manipulation and procedure.

The methods given are mostly sound and reliable. It appears unwise, however, to include such a brief method for the assay of platinum and palladium as that now inserted on pages 327-8. The method is, moreover, not reliable, as a good separation of ignited platinum and palladium cannot be made by simply warming the metals with nitric acid. This determination does not, by the way, appear in the index.

The subject matter and pagination of the remainder of the book are practically identical with those of the previous edition, and the book will doubtless continue to serve a useful purpose as a compilation of tested methods of ore analysis.

**TIN AND THE TIN INDUSTRY. THE METAL HISTORY, CHARACTER AND APPLICATION.** By A. H. Munday. Pp. xiii + 130,  $7\frac{1}{4} \times 4\frac{1}{4}$ . (London: Sir Isaac Pitman & Sons, Ltd., n. d.) Price 3s.

This little work, which forms one of Pitman's Common Commodities and Industries Series, is concisely written and well illustrated. The author, who is a trained technologist, gives an excellent account in it of the numerous commercial uses of tin, with many practical details with regard to the alloys and their application which are not to be found in ordinary text-books. The work forms an excellent introduction to larger treatises on the subject, and, at the same time, can be thoroughly recommended to all interested in the metal.



**MODERN COAL-WASHING PRACTICE.** By R. C. R. Minikin. Pp. 310,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (London: Ernest Benn, Ltd., 1928.) Price 45s.

The importance of preparing coal, not only for the foreign market, where British coal is under severe competition, but also for home use, and the rendering available of part at least of some of the immense reserves of slack, stacked around the collieries of Great Britain, in connection with pulverised fuel and low temperature carbonisation, is becoming increasingly recognised.

This book is therefore welcome. The author is an expert in his subject and the book is largely the results of his own experience, but German practice has been drawn upon also.

As might be expected, the general lay-out of all kinds of washing plants is dealt with and illustrated from actual practice. In addition there are descriptions of every variety of plant for coal handling and feeding, washing, water and froth concentration, dewatering of fine coal, etc.

Commercial considerations have not been neglected, for there is a chapter on washery products both in England and Scotland, and the mining of these products for sales purposes.

The book, which is one of the publishers' modern mining series of books in process of issue, besides being clearly written, is abundantly illustrated by photographs, diagrams and dimensioned drawings, and will appeal at once to the colliery engineer; but the metal mining engineer will also find much to learn from it.

**MANUFACTURE AND USES OF CONCRETE PRODUCTS AND CAST STONE.** By H. L. Childe. Pp. x + 248,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: Concrete Publications Limited, 1927.) Price 5s.

Although there is much in this work to interest the general user of concrete, it will probably appeal most strongly to those desirous of gaining a practical knowledge of the methods employed in the manufacture of pre-cast goods.

In the compilation of the early chapters, the author has drawn freely upon the work of Professor Abrams of the Lewis Institute, Chicago; but specific references to the sources of information—such for instance as the effect of impure waters on the strength of concrete—which the reader would find of much value, are not given.

It is to be regretted that in the discussion of Abrams' method (p. 22) for ascertaining the "Fineness Nodules"

of aggregates, the importance of the relative size of aperture of the sieves is not emphasised. "Openings to the linear inch" are meaningless unless the diameter of the wires is also specified.

The reader is apt to feel that insufficient care has been exercised in revising the work for the press, otherwise there would not have occurred such an unfortunate error as that in Table 5 on p. 23, wherein the Fineness Nodules of the sand is recorded as 3.15 instead of 3.6 owing to misplacement of some of the units in the column of figures; and on the same page, in discussing the plotted results of Fig. 9, the word "fine" is used where it should obviously be "coarse."

The graph shown in Fig. 52, p. 78, should have a cipher in place of unity, while the conclusions based on the plotted results and recorded both at the foot of the graph and on p. 82 are only partly correct.

The work is well arranged and printed, and concludes with a complete index both of subject matter and illustration. It should meet with a large sale, as it gives much detailed information and is a useful addition to the literature of the subject of which it treats.

**THE WATER SUPPLY OF TOWNS AND THE CONSTRUCTION OF WATERWORKS.** A Practical Treatise for the use of Engineers and Students of Engineering. By W. K. Burton, Assoc.M.Inst.C.E. Fourth Edition, in two volumes, by J. E. Dumbleton, Assoc.M.Inst.C.E. Vol. I. Collection and Purification Works. Pp. xvi + 137, 9 $\frac{1}{4}$   $\times$  7 $\frac{1}{4}$ . Vol. II. Works for Distribution. Pp. xv + 160, 9 $\frac{1}{4}$   $\times$  7 $\frac{1}{4}$ . (London: Crosby, Lockwood & Son, 1928.) Price 25s. per volume.

These volumes are a revision by J. E. Dumbleton of Burton's standard work on Water Supply. Care has been taken to preserve as far as possible the character of the original book and at the same time to embody the many improvements which have taken place in recent years.

Volume I, Collection and Purification Works, deals exhaustively with the questions of quality and quantity of water needed, sources of supply, and methods of estimating the quantity available from a given source. The various methods of storing water, involving different engineering problems, are then considered. The important question of the purification of natural waters in order to render them potable, by chemical means and also by storage and filtration, either by sand or rapid mechanical filters is adequately dealt with. The softening of hard waters

both for municipal and for special industrial purposes is considered from the engineering point of view, the chemical treatment of this question being touched upon without much detail of reactions involved or of difficulties encountered in the treatment of special cases.

Volume II deals with the engineering works involved in the distribution of water supplies. The different types of reservoirs and filter beds are described. The latest forms of pumping machinery are dealt with, followed by a chapter describing the hydraulic flow of water in different forms of conduit, both open and closed, and the various systems of distribution from the largest mains down to domestic supply pipes. The author emphasises strongly the need for the provision of a supply of water adequate for the extinction of fire at any point of the distribution system. An account is then given of causes and methods of prevention of waste of water, which constitutes one of the most troublesome problems of the waterworks engineer. Of recent years, however, the detection and prevention of waste of water has improved considerably.

The second volume contains as appendices papers by Professor John Milne, F.R.S., on "Considerations Concerning the Probable Effects of Earthquakes on Waterworks, and the special Precautions to be taken in Earthquake Countries," and by John de Rijke, C.E., on "Sand Dunes and Dune Sand as a Source of Water Supply."

Each volume is well illustrated with diagrams and is provided with a separate index. The printing and general appearance of the volumes are excellent. The work as a whole deals with the various problems involved in the engineering side of waterworks and water supply in a thoroughly satisfactory manner.

A MANUAL OF FIELD ASTRONOMY. By Andrew H. Holt. Second Edition. Pp. xiv + 126,  $6\frac{1}{2} \times 4$ . (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 10s.

This book, written by a professor at the University of Iowa, aims at giving in a very concise form all that is necessary to know about the determination of latitude, longitude, azimuth, and time in the field, and in this the author has succeeded very well. With the aid of the descriptions of the selected methods and the practical suggestions given, it is possible to make all the observations required when using the theodolite, or in some cases, the sextant. The book replaces with advantage the usual single chapter devoted to the subject in the ordinary textbooks on surveying, and, although strongly bound and

printed on tough paper, it is so convenient in size that it easily slips into the pocket.

Two appendixes are supplied, the one giving a convenient summary of spherical trigonometry, the other, descriptions and uses of the solar attachments usually supplied with a theodolite. A number of specimen note-book pages illustrate the methods of recording observations in the field.

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### BOOKS RECEIVED

**PRODUCTS OF THE EMPIRE.** By J. Clinton Cunningham, B.A. New issue. Pp. viii + 299,  $7\frac{1}{2} \times 4\frac{1}{2}$ . (Oxford: The Clarendon Press, 1928.) Price 3s. 6d.

**SILVICULTURAL SYSTEMS.** By R. S. Troup, C.I.E., D.Sc., F.R.S. Pp. xii + 199,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Oxford: The Clarendon Press, 1928.) Price 21s.

**A TEXT-BOOK OF SYSTEMATIC BOTANY.** By Deane B. Swingle. Pp. xiii + 254,  $9 \times 6$ . (London: McGraw-Hill Publishing Co., Ltd., 1928.) Price 10s.

**COMPARATIVE MORPHOLOGY OF FUNGI.** By Ernst Albert Gaumann, translated and revised by Carroll William Dodge. Pp. xiv + 701,  $9 \times 6$ . (London: McGraw-Hill Publishing Co., Ltd., 1928.) Price 37s. 6d.

**THE ASLIB DIRECTORY.** A Guide to Sources of Specialised Information in Great Britain and Ireland. Edited by G. F. Barwick, B.A. Pp. xiii + 425,  $11 \times 7\frac{1}{2}$ . (London: Published jointly by The Association of Special Libraries and Information Bureaux and The Oxford University Press, 1928.) Price 21s.

**DIRECTORY OF PAPER MAKERS OF GREAT BRITAIN AND IRELAND FOR 1928.** Pp. 272,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (London: Marchant Singer & Co., 1928.) Price 5s.

**COLLOID SYMPOSIUM MONOGRAPH.** Papers presented at the Fifth National Symposium on Colloid Chemistry, University of Michigan, June, 1927. Edited by Harry Boyer Weiser. Pp. 394,  $9 \times 6$ . (New York: The Chemical Catalog Company, Inc., 1928.) Price \$6.50.

**THE GEOLOGY OF MALAYAN ORE-DEPOSITS.** By J. B. Scrivenor, M.A., F.G.S. Pp. xv + 216,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: Macmillan & Co., Ltd., 1928.) Price 16s.

BRITAIN'S FUEL PROBLEMS. Pp. ci + 592, 11 × 5½.  
(London: *The Fuel Economist*, 1927.) Price 42s.

PETROLEUM-VADEMECUM. By Ing. Robert Schwarz.  
Fifth edition. Pp. 457, 6 × 4¾. (Berlin and Vienna:  
Verlag für Fachliteratur, 1928.) Price 15 marks.

THE DETERMINATION OF MINERALS UNDER THE MICRO-  
SCOPE. By John W. Evans, C.B.E., D.Sc., LL.B., F.R.S.,  
F.G.S. Pp. xii + 110, 7½ × 4¾. (London: Thomas  
Murby & Co.; New York: D. Van Nostrand Co.,  
1928.) Price 7s. 6d.

## REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

*Selected from the Reports made to the Dominion, Colonial  
and Indian Governments*

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### TIMBERS FROM THE GOLD COAST—II

IN a previous number of this BULLETIN (1926, 24, 417), reference was made to the investigation of a large series of Gold Coast timbers now being undertaken at the Imperial Institute, and the results of mechanical and working tests of seven of the timbers were given, together with remarks on the possibility of marketing them in the United Kingdom. The timbers then dealt with comprised Subaha (*Mitragyna macrophylla* Hiern), Attabini or Niankuma (*Tarrietia utilis* Sprague), Baku (*Mimusops* sp.), Kaku or Ironwood (*Lophira procera* A. Chev.), Odum (*Chlorophora excelsa* Benth. and Hook.), Penkwa or African Cedar (*Entandrophragma* sp.), and Konkuma (possibly *Morinda citrifolia* Linn.). In the present part four further timbers are dealt with.

8. *Achin* or *Takwadua* (*Blighia sapida* Koen.).—Natural Order Sapindaceæ. This tree is stated to be common in the Colony and attains an average girth of 8 ft.

9. *Awieforsemnea*.—The botanical identity of the tree yielding this timber has not yet been determined. It is stated that the tree is fairly common in the Colony and that it attains an average girth of 7 ft.

10. *Kwabohora* or *Kwatendro* (*Entandrophragma* sp.).—Natural Order Meliaceæ. This is one of the timbers exported under the name of African cedar, and is said to be used locally for furniture. The tree appears to be uncommon in the Colony and attains an average girth of 10 ft.

11. *Ananta* or *Takroa* (*Cynometra* sp.).—Natural Order Leguminosæ. According to the *Gold Coast Manual, Forestry Supplement*, this tree is uncommon in the Colony, but Chipp (*A List of Trees, Shrubs and Climbers of the Gold Coast, Ashanti and the Northern Territories*) states that it is very common in places in the evergreen forest. It attains an average girth of 8 ft.

The mechanical tests were carried out on clear, straight-grained specimens of the timbers by the methods described in the previous article. As in the case of the other timbers dealt with, specimens of the timbers, together with the results of the laboratory examination, were submitted to the Imperial Institute Advisory Committee on Timbers, who furnished reports on their possible uses and value.

#### 8. ACHIN OR TAKWADUA (*BLIGHIA SAPIDA*)

The specimens of Achin wood received at the Imperial Institute consisted of two planks, 12 ft. long, 26 in. wide and 2 and 3 in. thick. The planks were cracked up the middle but otherwise the wood was in sound condition.

The grain was moderately coarse and open, slightly wavy and alternating spiral.

In *transverse section* the heartwood was dark reddish-brown; the sapwood, which was about 1 in. wide, was light greenish-brown. The pores were of medium size, fairly numerous, arranged in radial rows, and were conspicuous on account of their whitish contents. As seen with a lens, the rays were very numerous, fine, dull pinkish lines, whilst the rings were vaguely indicated by narrow dark bands and by fine whitish lines as boundaries.

In *radial section* the colour was golden brown, the surface being slightly lustrous. The pores were of medium size and partially filled with whitish contents; the alternating spiral grain was clearly indicated in this section. The rays appeared as numerous, parallel, reddish bands, whilst the rings were invisible.

In *tangential section* the colour was light reddish-brown and the pores were conspicuous. The rays were seen with a lens as short, tapering, fine, reddish lines; the rings

were indicated by their boundaries, which were undulating, whitish lines, and by the variation in colour of the wood from light to dark.

*Results of Mechanical Tests on Air-dry Timber*

		Maximum.	Minimum.	Mean.
<i>Static bending :</i>				
Maximum calculated longitudinal shear . . .	lb./sq. in.	812	473	633
Fibre stress at elastic limit . . .	"	10,930	8,250	9,510
Modulus of rupture . . .	"	23,190	13,240	17,880
Modulus of elasticity . . .	"	2,680,000	2,210,000	2,411,000
Work in bending to elastic limit . . .	inch-lb./cu. in.	2.44	1.51	1.92
Work in bending to maximum load . . .	"	19.94	7.94	11.72
<i>Compression parallel to grain :</i>				
Fibre stress at elastic limit . . .	lb./sq. in.	6,820	5,360	6,180
Maximum crushing strength . . .	"	10,880	8,830	9,800
Modulus of elasticity . . .	"	3,273,000	2,240,000	2,703,000
<i>Compression perpendicular to grain :</i>				
Fibre stress at elastic limit . . .	lb./sq. in.	1,990	1,780	1,880
<i>Shearing parallel to grain :</i>				
Shearing strength :				
Surface of failure :				
Radial . . .	lb./sq. in.	2,290	1,720	1,990
Tangential . . .	"	2,570	1,960	2,250
<i>Cleavage :</i>				
Splitting strength :				
Surface of failure :				
Radial . . . lb. per inch width		462	344	388
Tangential . . .	" "	863	653	775
<i>Tension perpendicular to grain :</i>				
Tensile strength :				
Surface of failure :				
Radial . . . lb./sq. in.		1,153	825	934
Tangential . . .	"	2,165	1,376	1,844
<i>Hardness :</i>				
Load required to imbed a 0.444 inch steel sphere to one-half its diameter :				
Radial surface . . . lb.		2,810	1,860	2,290
Tangential surface . . .	"	2,520	1,860	2,220
End surface . . .	"	2,480	1,800	2,070
Specific gravity . . .		0.887	0.758	0.831
Moisture . . . per cent.		18.5	13.4	16.3
Weight per cubic foot . . . lb.		64.0	55.3	60.5



*Results of Working Tests*

(1) *Sawing*.—The wood cuts moderately easily with machine saws but is more difficult to work with hand saws.

(2) *Planing*.—It is hard to plane but good results are obtainable ; care is needed on a radial surface as " picking up " occurs owing to the alternating spiral grain.

(3) *Boring*.—Gimlets can be used fairly readily but not bradawls ; centre bits, auger bits and morse drills give clear holes without much difficulty.

(4) *Nailing and Screwing*.—Nails and screws are very difficult to drive in and there is a tendency for the wood to split, but they hold very firmly.

(5) *Working with Gouge and Chisel*.—The wood cuts fairly easily but tears up badly when cut against the grain.

(6) *Mortising and Dovetailing*.—It works well in mortising machine and strong joints are obtainable.

(7) *Turning*.—It cuts fairly readily in the lathe, giving a good finish with tools and an excellent finish with glass paper.

(8) *Glueing*.—Moderately strong joints are obtainable.

(9) *Polishing and Varnishing*.—Satisfactory results are obtained when care is taken.

(10) *Staining*.—The wood does not absorb stain readily.

*Remarks*

Achin is a hard, heavy wood. It works fairly readily with machine tools but offers some difficulty with most hand tools. A good finish is obtainable if care is taken.

The wood is stiff and shows good strength in transverse bending, compression parallel and perpendicular to the grain and shearing. Its resistance to radial cleavage and to radial tension perpendicular to the grain is comparatively low, owing to failure along the rays, which are less hard and strong than the rest of the wood. Similarly in the hardness test on the end surface, the results are relatively low as the wood tends to split along the rays.

The wood shrinks considerably except in a radial direction, has a tendency to check, and warps slightly.

The Timbers Committee considered that the colour, fine texture and sheen of Achin render it not unattractive

in appearance, but the timber possesses no special features likely to recommend it as a decorative wood for use in this country. The comparatively heavy weight and the generally unfavourable character of the results of the working trials carried out in the laboratory would seem to preclude the use of the timber for purposes other than heavy construction work in the country of production. The general character of the timber suggests that it may possess considerable durability. There appears to be no prospect of marketing Achin in this country.

#### 9. AWIEFORSEMNEA

The specimens of this wood received at the Imperial Institute consisted of two planks, 10 ft. long, approximately 2 ft. wide and 3 in. thick. The wood was in sound condition but the centre portions of the planks were cracked. The grain was slightly alternating spiral, fairly coarse and open.

In *transverse section* the heartwood was dark reddish-brown ; the sapwood was light pinkish-brown, with some greenish-grey discolourations, and was about 2 in. wide. The pores were fairly large and numerous, usually arranged in approximately radial rows of single pores, and bordered by a concentric layer of soft tissue slightly lighter in colour than the ground tissue ; resinous contents were occasionally visible. The rays appeared as inconspicuous, fairly numerous, dark orange-brown, fine lines. The rings were ill-defined by the boundary between the darker, slow growth wood and the lighter fast growth wood.

In *radial section* the wood was of lighter shade than in the transverse section, and the pores were usually partly obscured by the soft tissue which appeared as narrow, brownish borders to the pores somewhat darker than the ground tissue ; resinous contents were often visible in the exposed pores. The rays were seen as very narrow, dark orange-brown lines, whilst the rings were vaguely indicated by the darker bands of slower growth wood. The section showed the ribbony appearance due to alternating spiral grain.

In *tangential section* the wood was light reddish-brown to orange-brown with a slightly lustrous surface ; the

borders to the pores were broader than in the radial section giving a very coarse-grained appearance to the wood. The rays were very numerous and could be distinguished with a lens as very short, fine, orange-brown lines ; the rings were indicated by undulating darker bands.

### *Results of Mechanical Tests on Air-dry Timber*

		Maximum.	Minimum.	Mean.
<i>Static bending :</i>				
Maximum calculated longitudinal shear . . .	<i>lb./sq. in.</i>	454	294	366
Fibre stress at elastic limit . . .	"	9,290	6,540	8,010
Modulus of rupture . . .	"	12,950	8,320	10,400
Modulus of elasticity . . .	"	1,772,000	1,324,000	1,507,000
Work in bending to elastic limit . . .	<i>inch-lb./cu. in.</i>	2.64	1.64	2.23
Work in bending to maximum load . . .	"	6.02	2.96	4.40
<i>Compression parallel to grain :</i>				
Fibre stress at elastic limit . . .	<i>lb./sq. in.</i>	4,510	3,730	4,090
Maximum crushing strength . . .	"	8,410	6,390	7,350
Modulus of elasticity . . .	"	2,210,000	1,357,000	1,731,000
<i>Compression perpendicular to grain :</i>				
Fibre stress at elastic limit . . .	<i>lb./sq. in.</i>	1,091	791	963
<i>Shearing parallel to grain :</i>				
Shearing strength :				
Surface of failure :				
Radial . . .	<i>lb./sq. in.</i>	1,142	823	963
Tangential . . .	"	1,455	1,070	1,255
<i>Cleavage :</i>				
Splitting strength :				
Surface of failure :				
Radial . . .	<i>lb. per inch width</i>	358	245	309
Tangential . . .	" "	370	199	285
<i>Tension perpendicular to grain :</i>				
Tensile strength :				
Surface of failure :				
Radial . . .	<i>lb./sq. in.</i>	677	508	597
Tangential . . .	"	744	525	616
<i>Hardness :</i>				
Load required to imbed a 0.444 inch steel sphere to one-half its diameter :				
Radial surface . . .	<i>lb.</i>	860	670	760
Tangential surface . . .	"	1,060	810	940
End surface . . .	"	1,190	900	1,050
Specific gravity . . .		0.560	0.427	0.506
Moisture . . .	<i>per cent.</i>	21.5	10.7	13.5
Weight per cubic foot . . .	<i>lb.</i>	42.4	30.5	36.1

*Results of Working Tests*

(1) *Sawing*.—The wood cuts easily with hand and machine saws.

(2) *Planing*.—The wood " picks up " badly on a radial surface but gives good results on a tangential surface.

(3) *Boring*.—Machine and hand boring tools can be used readily and give fairly clean holes ; there is a tendency to tear up with centre bits.

(4) *Nailing and Screwing*.—Nails and screws can be driven in easily without splitting the wood and hold fairly firmly.

(5) *Working with Gouge and Chisel*.—The wood cuts easily and cleanly with the grain, but tears up badly against the grain.

(6) *Mortising and Dovetailing*.—The wood cuts readily in the mortising machine but not very cleanly ; joints have only moderate strength.

(7) *Turning*.—The wood cuts easily in the lathe but tends to tear up. Well-sharpened tools are necessary to obtain a good surface ; glass-papering gives a smooth finish.

(8) *Glueing*.—The glue adheres firmly to the wood and gives a strong joint.

(9) *Staining*.—The wood absorbs stains well.

(10) *Polishing*.—A number of applications are necessary to obtain satisfactory results as the wood absorbs the polish readily.

(11) *Varnishing*.—Fairly satisfactory results are obtainable.

*Remarks*

Awieforsemnea is a soft, moderately light wood. It works readily with all machine and hand tools and finishes fairly well, though much care is needed on a radial surface. It has little tendency to warp and does not shrink unduly or " check " when dried.

The wood has moderate strength in transverse bending and compression parallel to the grain, and is of average stiffness. Its resistance to cleavage is low ; to compression perpendicular to the grain fairly low ; to shear and to tension perpendicular to the grain moderate.

The Timbers Committee regarded this timber as having

no marked "character" which would give it an assured position in this market; if, however, the timber is available at a sufficiently low price and in regular shipments it could no doubt be sold in competition with the cheaper grades of "mahogany." The laboratory report indicates that the "finishing" qualities of the wood are not altogether satisfactory, but the timber would probably be suitable for interior work in the furniture and allied trades. The timber should be useful locally for general construction purposes where an easy working material of moderate strength is required. The texture of the wood resembles that of "Nyankon" exported from the Ivory Coast, but the two woods are different in colour.

The general uses of timbers of this character, and their market prospects, were mentioned in the Committee's report on Baku (this BULLETIN, 1926, 24, 430).

#### 10. KWABOHORA OR KWATENDRO (*ENTANDROPHRAGMA* SP.)

The specimens received at the Imperial Institute consisted of two planks,  $9\frac{1}{2}$  ft. long,  $2\frac{1}{2}$  ft. wide and 2 in. and 3 in. thick. The wood was in sound condition.

The grain was straight with a slight tendency to be alternating spiral; it was moderately coarse and open.

In *transverse section* the sapwood was light yellowish-brown with greyish discolourations and about 1 in. wide; there was then an intermediate zone of light pinkish-brown wood about 4 in. wide before the typical light reddish-brown heartwood was reached. The pores were very numerous, medium-sized, often in radial groups of two or three and usually joined by fine, undulating, continuous, concentric lines of light pinkish, soft tissue. The rays were visible as very numerous, fine, light pinkish lines and the rings were indicated by narrow bands of darker wood as their boundaries.

In *radial section* the heartwood was light pinkish-brown with sapwood of a lighter shade. The pores appeared as long, narrow, orange-brown grooves occasionally having light red contents and the soft tissue could be seen as fine, pale pinkish lines. The rays were visible as narrow, parallel, dull pinkish stripes, whilst the rings were indicated vaguely by narrow, parallel lines of slightly darker wood.

In *tangential section* the colour of the wood and the appearance of the pores were similar to those of the radial section. The soft tissue was more conspicuous as it appeared as slightly broader, dull pinkish stripes, or zig-zag continuous bands surrounding or joining the pores. The rays were visible through a lens as innumerable, fine, short, pinkish lines. The rings could not be definitely distinguished.

*Results of Mechanical Tests on Air-dry Timber*

<i>Static bending :</i>		Maximum.	Minimum.	Mean
Maximum calculated longitudinal shear . . . <i>lb./sq. in.</i>		550	493	526
Fibre stress at elastic limit . . . "		9,450	8,400	8,990
Modulus of rupture . . . "		15,430	13,810	14,780
Modulus of elasticity . . . "		1,848,000	1,550,000	1,707,000
Work in bending to elastic limit . . . <i>inch-lb /cu. in.</i>		2.75	2.17	2.46
Work in bending to maximum load . . . "		14.60	9.05	10.72
<i>Compression parallel to grain .</i>				
Fibre stress at elastic limit <i>lb /sq. in.</i>		4,670	3,620	4,100
Maximum crushing strength . . . "		8,180	6,980	7,610
Modulus of elasticity . . . "		2,298,000	1,530,000	1,997,000
<i>Compression perpendicular to grain .</i>				
Fibre stress at elastic limit <i>lb /sq in.</i>		1,255	1,055	1,142
<i>Shearing parallel to grain .</i>				
Shearing strength :				
Surface of failure :				
Radial . . . <i>lb /sq. in.</i>		1,610	1,230	1,460
Tangential . . . "		2,070	1,620	1,870
<i>Cleavage :</i>				
Splitting strength .				
Surface of failure .				
Radial . . . <i>lb per inch width</i>		489	417	454
Tangential . . . " "		728	465	652
<i>Tension perpendicular to grain</i>				
Tensile strength :				
Surface of failure :				
Radial . . . <i>lb./sq. in.</i>		1,146	808	942
Tangential . . . "		1,515	1,110	1,322
<i>Hardness :</i>				
Load required to imbed a 0.444 inch steel sphere to one-half its diameter				
Radial surface . . . <i>lb</i>		1,050	850	970
Tangential surface . . . "		1,240	930	1,080
End surface . . . "		1,480	1,160	1,340
Specific gravity . . . . .		0.480	0.416	0.449
Moisture . . . . . <i>per cent.</i>		14.8	11.5	12.8
Weight per cubic foot . . . <i>lb.</i>		39.1	32.2	36.4

*Results of Working Tests*

(1) *Sawing*.—The wood cuts readily with hand and machine saws.

(2) *Planing*.—It planes fairly easily but there is a slight tendency to "pick up" on a radial surface.

(3) *Boring*.—All boring tools give clean holes with moderate ease.

(4) *Nailing and Screwing*.—Nails and screws can be driven in moderately easily; they hold firmly, and the wood does not split.

(5) *Working with Gouge and Chisel*.—The wood works easily; it tears up when cut against the grain.

(6) *Mortising and Dovetailing*.—It cuts easily and cleanly in the mortising machine; joints have moderate strength.

(7) *Turning*.—The wood cuts readily in the lathe, giving a smooth surface with tools and an excellent finish with glass-paper.

(8) *Glueing*.—Glued joints are fairly strong.

(9) *Staining*.—Satisfactory.

(10) *Polishing*.—The wood takes polish well and a good finish is obtainable.

(11) *Varnishing*.—Satisfactory.

*Remarks*

Kwabohora is a firm, fairly light wood. It works easily with most hand and machine tools, and finishes well. It possesses good average strength for its comparative lightness and compares favourably with Penkwa, *Entandrophragma* sp. (see this BULLETIN, 1926, 24, 437), which it resembles closely excepting that it is not wavy-grained.

Kwabohora is lighter than Penkwa, but is stronger in transverse bending, compression parallel to the grain and tangential shear; it is nearly twice as strong in its resistance to cleavage and tension perpendicular to the grain, equally hard and only slightly weaker in compression perpendicular to the grain and radial shear. It does not shrink unduly and has little tendency to warp or check. The wood is inclined to be brittle.

The Timbers Committee regarded this as a promising

timber, similar in appearance and character to Penkwa, though without the "curl" which was a feature in the sample of the latter timber examined by the Committee. The wood should find a ready market in this country as a "scented mahogany" if supplies and price are satisfactory, and would doubtless have many local uses.

As regards the general uses of timbers of this character, and their market prospects, see p. 282.

### II. ANANTA OR TAKROA (*CYNOMETRA SP.*)

The specimens of this wood received at the Imperial Institute consisted of two planks, 11 ft. long, about 27 in. wide and 2 and 3 in. thick. The wood was in sound condition but the planks were cracked up the middle.

The grain was alternating spiral and slightly wavy; the texture was fairly fine and compact.

In *transverse section* the sapwood was pinkish-brown, about 2 in. wide, and the heartwood dark brown. The pores were numerous, fairly small, and occasionally had reddish or whitish contents. The rays were invisible to the eye, but with the aid of a lens appeared as very fine, numerous, pinkish lines. The rings were indicated by the arrangement of the soft tissue which appeared as very narrow, continuous, concentric, pinkish-brown bands decreasing in width from the faster to the slower growth wood; the outer layer of the ring being a relatively wide band of ground tissue.

In *radial section* the heartwood was light brown and the pores were seen as narrow grooves slightly darker than the surrounding tissue. The rays were visible as very numerous, narrow, dull pinkish stripes; the rings were indicated by narrow, darker bands and the soft tissue showed as fine, pinkish, parallel lines. Slight rippling was visible in this section.

In *tangential section* the wood was slightly darker than in the radial section. The pores appeared as long, narrow grooves and the rays were visible through a lens as fine, short, pinkish lines. The soft tissue was conspicuous as dull pinkish stripes or zig-zag bands whilst the rings were indicated by narrow, undulating bands.



*Results of Mechanical Tests on Air-dry Timber*

<i>Static bending :</i>		Maximum.	Minimum.	Mean.
Maximum calculated longitudinal shear . . .	lb./sq. in.	715	644	683
Fibre stress at elastic limit . . .	"	9,610	8,430	8,910
Modulus of rupture . . .	"	20,000	18,020	19,020
Modulus of elasticity . . .	"	2,480,000	2,050,000	2,256,000
Work in bending to elastic limit . . .	inch-lb./cu. in.	2.10	1.68	1.84
Work in bending to maximum load . . .	"	23.1	15.2	18.5
<i>Compression parallel to grain :</i>				
Fibre stress at elastic limit . . .	lb./sq. in.	5,420	4,550	5,050
Maximum crushing strength . . .	"	10,080	9,050	9,650
Modulus of elasticity . . .	"	2,921,000	2,150,000	2,564,000
<i>Compression perpendicular to grain :</i>				
Fibre stress at elastic limit . . .	lb./sq. in.	1,980	1,680	1,830
<i>Shearing parallel to grain :</i>				
Shearing strength :				
Surface of failure :				
Radial . . .	lb./sq. in.	2,280	1,550	2,070
Tangential . . .	"	2,550	1,825	2,140
<i>Cleavage :</i>				
Splitting strength :				
Surface of failure :				
Radial . . .	lb. per inch width	353	300	323
Tangential . . .	" "	875	594	714
<i>Tension perpendicular to grain :</i>				
Tensile strength :				
Surface of failure :				
Radial . . .	lb./sq. in.	647	596	625
Tangential . . .	"	1,850	1,480	1,666
<i>Hardness :</i>				
Load required to imbed a 0.444 inch steel sphere to one-half its diameter :				
Radial surface . . .	lb.	2,870	2,280	2,540
Tangential surface . . .	"	2,720	2,340	2,520
End surface . . .	"	2,920	2,210	2,630
Specific gravity . . .		0.840	0.750	0.807
Moisture . . .	per cent.	21.2	14.6	17.8
Weight per cubic foot . . .	lb.	62.1	55.4	59.6

*Results of Working Tests*

(1) *Sawing*.—The wood cuts moderately easily with machine saws but is fairly hard to cut with hand saws.

(2) *Planing*.—It is not easy to plane and "picks up" badly on a radial surface.

(3) *Boring*.—Hand boring tools are difficult to use ; machine boring tools cut fairly readily but heat up and the wood steams.

(4) *Nailing and Screwing*.—The wood is too hard for nails as they bend over ; if fairly large holes are bored for screws they can be driven in and hold very firmly.

(5) *Working with Gouge and Chisel*.—It cuts cleanly and fairly readily with the grain but tears up badly against the grain.

(6) *Mortising and Dovetailing*.—The wood is hard to cut in the mortising machine but clean slots are obtainable. The joints are very strong.

(7) *Turning*.—It cuts moderately easily in the lathe, giving a fairly clean finish with sharp tools and a smooth finish with glass-paper.

(8) *Glueing*.—Joints are not very strong as the glue does not adhere well to the wood.

(9) *Staining*.—Fairly satisfactory.

(10) *Polishing and Varnishing*.—Good results are obtainable.

#### *Remarks*

Ananta is a hard, heavy wood. It works with some difficulty with hand tools but more readily with machine tools ; a good finish is obtainable, though care is needed in planing.

The wood is stiff and very strong in transverse bending and compression parallel to the grain. Its resistance to compression perpendicular to the grain, shear and indentation is fairly high. As regards tension perpendicular to the grain and cleavage it shows good strength in the tangential plane, but in comparison its resistance in the radial direction is low.

The wood has a slight tendency to check and shrinks considerably when dried out from the green condition.

The Timbers Committee expressed the opinion that in view of the somewhat unsatisfactory working qualities of the timber, and the reported relative scarcity of the tree in the Gold Coast, it is unlikely that the timber would find a commercial opening in this country. Heavy and hard timbers of this character have in any case comparatively limited applications, but the wood might be useful in the

Colony for purposes where weight is of secondary importance and where a strong timber is required ; bridge building, railway work and general heavy construction were suggested in this connection. The possibility of using the wood as a mining timber might also be considered.

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### TOBACCO FROM NEW ZEALAND

A SMALL quantity of tobacco has been grown in New Zealand for local use for some years, and recently considerable interest has been evinced in tobacco cultivation as a commercial proposition. It has been demonstrated that leaf of good quality, both for pipe smoking and for cigarettes, can be produced in certain localities in the Dominion, notably Nelson, Hawke's Bay and Auckland. The estimated area under cultivation in 1925-26 was about 400 acres, the crop being grown under contract with tobacco manufacturers.

It is recorded in the Annual Report of the Department of Agriculture for 1926-27, that, in order to assist in ascertaining the possibility of establishing an export trade in New Zealand grown tobacco leaf, the Government recently granted a guarantee to growers on all tobacco leaf officially approved for export. The guarantee was offered in respect of leaf exported during 1927, 1928 and 1929, and the grower was assured of an average gross market price of 2s. 3d. per lb. on the open market in London on all leaf of Class I, and 1s. 4d. per lb. on leaf of Class II, the gross liability of the Government not to exceed £3,500 in any one year. The offer is stated to have been taken advantage of by a number of growers in the Motueka district, but developments took place later which precluded the possibility of the Government being called upon to proceed with the guarantee for the 1926-27 season. In this district 30 acres were specially planted under the supervision of an Instructor in Tobacco-culture, appointed by the Department of Agriculture. All operations (planting, cultivation, curing, etc.) were carried out under the direction of the Instructor, and it was hoped that some 10-20 tons of leaf would be available for export. According to

the trade returns, however, the quantity of locally produced unmanufactured tobacco exported from New Zealand in 1927 amounted to only 912 lb., of which 764 lb. was shipped to the United Kingdom and 148 lb. to Australia.

At the request of the High Commissioner for New Zealand, samples of the various grades of leaf received for sale in London were withdrawn for investigation at the Imperial Institute, in order to determine their quality and characteristics with a view to the improvement of the leaf on further cultivation.

The samples were as follows :

Case and Sample	Size of Leaf.	Colour of Leaf	Texture of Leaf.
DR 608/1. First quality bright leaf	Rather narrow. From 18 × 7 to 24 × 9 in.	Yellow to orange, showing green- ness, in some rather badly.	Good substance, but some leaves lacking strength and much broken. Butts gen- erally fairly well covered, but 1 in. could be removed with advantage. Midrib fair.
DR 933/2. Low grade dark flue- cured leaf	A mixture of long and short leaves. From 15 × 6 to 25 × 8 in.	Variable; from mottled orange through maho- gany to rather dark reddish- brown. Some greenness.	Generally of good substance; some leaves lacked strength and were much broken. Butts fairly well covered; midrib fair.
DR 933/4. Medium quality, bright flue- cured leaf	Narrow leaves. From 15 × 6 to 24 × 8½ in.	Yellow to dark orange, show- ing much greenness and discolouration.	Good substance, but some leaves lacked strength and were much broken. Butts generally fairly well covered, but 1 in could be removed with ad- vantage. Midrib fair.
DR 941/1.* Top	Narrow leaves From 17½ × 6 to 26½ × 9 in.	Dark orange or orange brown, showing green- ness.	Good substance, some leaves lacked strength and were much broken. Butts as in DR 933/4. Midrib in- clined to be rather heavy.
DR 941/1.* Bottom	Narrow leaves From 17 × 5 to 23 × 8½ in.	Mottled orange, rather reddish, showing green- ness.	Substance as in DR 941/1 (Top). Butts and midribs simi- lar.

\* Case DR 941/1 contained two samples. From the appearance of the leaf, the top sample in the case was probably "good air-cured leaf" and the bottom sample "highest grade air-cured leaf."

The samples as received were found to contain the following quantities of moisture :

Sample.	Moisture. Per cent.
DR 608/1 . . . . .	16.5
DR 933/2 . . . . .	15.8
DR 933/4 . . . . .	17.3
DR 941/1 (Top) . . . . .	16.7
DR 941/1 (Bottom)	18.2

Chemical examination of the tobaccos gave the following results, which for convenience of comparison are calculated on the basis of 14 per cent. of moisture :

	DR 608/1. Per cent.	DR 933/2. Per cent.	DR 933/4. Per cent.	DR 941/1. (Top). Per cent.	DR 941/1. (Bottom). Per cent.
Moisture . . . . .	14.0	14.0	14.0	14.0	14.0
Nicotine . . . . .	3.14	5.17	3.21	5.18	6.62
Nitrogen . . . . .	1.64	3.66	2.11	2.70	3.24
Ash . . . . .	10.7	15.0	9.8	13.6	13.4

Smoking trials which were carried out showed that all the tobaccos burned well, but the smoke was rather pungent ; the flavour was mild in the case of DR 608/1 and DR 933/4, but in the three other samples it was coarse, and in the case of DR 933/2 also raw.

The tobaccos were submitted to merchants in London, who expressed the opinion that they appeared somewhat unfinished and that it might hardly be fair to judge the products by the present samples, as if the leaf were grown on a larger and more commercial scale it could be better handled and cured. The firm stated that they would prefer to receive larger samples or sample packages, before expressing an opinion on the marketing of the tobaccos in the United Kingdom.

All the samples as received at the Imperial Institute were in too " easy " a condition and contained excessive amounts of moisture, viz. 15.8 to 18.2 per cent., against 12 to 14 per cent. which is the maximum desirable in commercial consignments. The tobaccos all showed greenness, particularly in the case of DR 608/1 and DR 933/4. The samples were on the whole of good substance, but some of the leaves were lacking in strength and in some cases the butts could have been shortened with advantage

by at least 1 in. In every case the tobacco was in rather broken condition, some leaves being badly damaged.

The results of chemical examination show that the dark-coloured samples contained high amounts of nicotine, particularly DR 941/1 (Bottom). The amount of nitrogen was also high in this sample and in DR 933/2, and somewhat high in DR 941/1 (Top).

The coarse flavour in the darker coloured samples corresponded with the presence of a higher amount of nitrogen than is desirable, and this may have been due to excessive nitrogenous manuring. Apart from this feature in the case of the darker leaf, the samples all compared favourably in flavour with other Dominion and Colonial-grown tobaccos and did not exhibit a marked "twang." On the whole the samples were of very promising character, particularly the two lighter coloured samples, for which there would be a larger demand than for the darker leaf. It was pointed out, however, they could be improved by better curing to eliminate greenness.

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## TOBACCO FROM UGANDA

THE two samples of tobacco which are the subject of this report were received at the Imperial Institute in November 1927 from the Director of Agriculture, Uganda. The tobaccos were stated to have been grown on rather heavy land at Bulindi, Bunyoro, Northern Province, and to have been cured by the open fire method.

No. 1.—This sample was stated to represent a heavy type of Virginia tobacco from seed grown at Serere Plantation, Teso District, for many years; the name of the variety was unknown.

The sample consisted of two hands of tobacco of an even darkish to medium warm brown colour. The leaf was of fair substance, but was rather papery along the midrib and inclined to be harsh and brittle. The midribs were rather heavy; the butts well feathered. The veins were small but wiry. The size of the leaves varied from 24 × 8 in. to 29 × 11 in.

No. 2.—This was stated to represent the variety "Piet

Retief Swazie," the seed of which was received from the Department of Agriculture at Pretoria.

The sample consisted of two hands of tobacco of an even medium warm brown colour. The leaf was lacking in substance, brittle and papery, especially along the midrib. The midribs were rather heavy; the butts well feathered. The veins were small but wiry. The size of the leaves varied from  $25 \times 10$  in. to  $28 \times 11$  in.

The two tobaccos were very similar in colour, but No. 1 was of better substance. Both samples were in good unbroken condition.

The tobaccos, after removal of the midribs, were analysed with the following results, which are calculated for leaf containing 14 per cent. of moisture :

	No. 1. <i>Per cent.</i>	No. 2. <i>Per cent.</i>
Moisture . . . . .	14.0	14.0
Nicotine . . . . .	5.59	5.66
Nitrogen . . . . .	4.43	4.42
Ash . . . . .	12.5	11.8

The ash of sample No. 1 was analysed with the following results :

	Ash as prepared. <i>Per cent.</i>	Calculated on CO <sub>2</sub> -free ash. <i>Per cent.</i>
Lime . . . . .	CaO 27.51	35.25
Magnesia . . . . .	MgO 12.73	16.31
Potash . . . . .	K <sub>2</sub> O 23.46	30.05
Soda . . . . .	Na <sub>2</sub> O 0.78	1.00
Sulphates, expressed as sulphuric anhydride	SO <sub>3</sub> 3.89	4.98
Chlorides, expressed as chlorine . . . . .	Cl 2.84	3.64
Carbonates, expressed as carbon dioxide	CO <sub>2</sub> 21.95	—

The foregoing results show that the two samples were of very similar composition and contained high percentages of nicotine and nitrogen. The composition of the ash (of No. 1) was satisfactory, the percentage of potash being normal and the total amounts of sulphates and chlorides satisfactorily low.

Smoking trials showed that the leaf of sample No. 1 burned satisfactorily, leaving a white ash, but the flavour was considered to be rather coarse and pungent. The flavour of No. 2 was generally similar, but the combustion was not quite so good.

The samples were submitted to merchants and manufacturers who reported on them as follows :

(1) The merchants stated that both samples represented a very good and useful type of leaf comparing very favourably with similar classes of tobacco produced in Southern Rhodesia and Nyasaland. Such leaf could probably be utilised as a spinning wrapper in the United Kingdom. Of the two samples, the firm described No. 2 as the leafier and wider and probably more useful for the purpose mentioned, except that the stalk was rather markedly heavy, especially at the butt ends, which would be a disadvantage. No. 1 had relatively a much smaller stalk, and this factor might outweigh its inferiority to No. 2 as regards leafiness and width.

The firm were of opinion that bulk shipments of tobacco of similar quality to the samples, i.e. equally leafy and broad, should realise about 1s. 8d. to 1s. 9d. per lb. in London (March 1928), but they pointed out that at that time the market for Colonial tobacco was affected by the large increase in production which had recently taken place, especially in Nyasaland and Rhodesia.

(2) The manufacturers expressed themselves as favourably impressed with the tobaccos, especially with sample No. 1, which they described as having length, very fair body, good texture and appearance, and a pleasantly fired flavour. They stated that No. 2 had a pleasing appearance but was inferior to No. 1 in body and texture. They pointed out, however, that the final test of the leaf would be its smoking quality when manufactured, and stated that if a few trial bales of the Virginia tobacco represented by sample No. 1 could be forwarded to them they would be glad to carry out manufacturing tests and furnish an opinion as to the value of the leaf and the prospects of marketing it in the United Kingdom.

It will be seen that these two samples of tobacco were of promising quality. The amounts of nicotine and nitrogen present in the leaf were, however, high and adversely affected the flavour of the tobacco when smoked. High percentages of these constituents are often due to excessive nitrogenous manuring.

It was suggested to the Uganda authorities that it would appear advisable to take advantage of the offer of the manufacturers to receive a few trial bales for practical



tests, and that if it were found possible to arrange for such a shipment, the Imperial Institute would be glad to give any assistance that might be required in connection with the matter.

### CAMPHOR LEAVES AND TWIGS FROM ST. LUCIA—II

IN the course of a report on samples of camphor leaves and twigs produced on an experimental plantation in the Botanic Gardens, Reunion, St. Lucia (see this BULLETIN, 1927, 25, 6), the Imperial Institute offered to conduct an investigation of material collected from individual trees in order to ascertain which of the trees gave the greatest yield of oil and camphor. Samples of leaves and twigs were subsequently forwarded for examination in August 1927. They were stated to have been collected from twenty trees in the same plot from which the two earlier samples were derived, and to have been air-dried for 31 days.

The samples were examined with the following results :

Sample No.	Moisture.	Amount of total distillate (camphor and oil).		Camphor separated mechanically from total distillate on cooling to 0° C.		
		Expressed on original material.	Expressed on moisture-free material.	Expressed on original material.	Expressed on moisture-free material.	Expressed on total distillate (camphor and oil).
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
1	7.3	2.85	3.1	2.2	2.4	77.9
2	6.7	2.7	2.9	1.9	2.05	70.4
3	6.2	2.0	2.1	1.35	1.45	68.6
5	6.5	1.35	1.45	1.05	1.1	76.6
6	9.1	1.95	2.1	1.45	1.6	75.6
7	8.5	2.3	2.55	1.8	1.95	76.7
8	8.4	2.35	2.55	1.55	1.7	66.4
9	8.3	2.2	2.4	1.75	1.9	78.6
10*	9.2	—	—	1.7	1.85	—
11	9.0	2.0	2.2	1.4	1.55	71.3
12	8.7	2.4	2.6	1.65	1.8	69.4
13	8.8	2.25	2.45	1.65	1.8	74.5
14	8.4	2.1	2.3	1.45	1.6	70.0
15	6.9	2.4	2.6	1.75	1.85	71.5
16	7.4	2.25	2.45	1.5	1.65	67.3
17	7.1	2.1	2.3	1.45	1.55	68.9
18	6.5	2.05	2.15	1.45	1.55	70.9
19	7.2	2.1	2.3	1.55	1.7	73.9
20	6.5	1.85	2.0	1.25	1.35	66.4
21	6.1	1.65	1.75	1.1	1.15	65.4

\* Through an accident in the laboratory a considerable proportion of the oil and some of the camphor from this sample were lost. No figure therefore is quoted for the total distillate, and the amounts of separated camphor are slightly low.

The proportions of leaves and twigs were generally similar in all cases although a somewhat larger quantity of thick twigs was present in some of the samples than in others.

From the foregoing results it will be seen that sample No. 1 gave the best yield of total distillate (camphor and oil) and also the highest percentage of actual camphor, viz. 3.1 and 2.4 per cent. respectively, expressed on the moisture-free material. The lowest yields were obtained from samples Nos. 5 and 21 which furnished less than half as much camphor as No. 1. In the other 17 samples the greatest variation in the yields of camphor amounted to a difference of only 0.7 per cent., expressed on the moisture-free material.

The average yield of camphor from the twenty samples as shown in the table was about 1.7 per cent., expressed on the moisture-free material. This figure represents the amount of camphor which could be separated from the total distillate on cooling to 0° C., but the residual oil may be expected to contain about 25 to 30 per cent. of its weight of camphor, equivalent to an additional 0.2 to 0.3 per cent. of camphor expressed on the moisture-free leaves and twigs. In order to determine definitely the amount of camphor retained in the residual oil, fractionation experiments would be necessary, but this operation could not be satisfactorily carried out in the present instance owing to the small quantities of residual oil available.

In the last column of the table the separated camphor is expressed in each case as a percentage of the total distillate. From these figures it will be seen that sample No. 9 furnished the distillate containing the highest proportion of camphor, whilst the distillate from No. 21 contained the least camphor, and therefore the largest amount of oil.

With the exception of No. 1 the present samples all furnished rather lower amounts of camphor than the samples from St. Lucia which were the subject of the earlier report of the Imperial Institute, but the yields were generally in agreement with those recorded for camphor leaves and twigs from other sources (cf. table, *loc. cit.* p. 7).

In connection with any proposal to extend the cultivation of camphor trees in St. Lucia, it was mentioned that the Imperial Institute Advisory Committee on Essential Oils and Resins had recently given special attention to the question of the production of natural camphor in the Empire. After careful consideration of the information placed before them regarding the market position of camphor, the results of its experimental cultivation and production in the Empire, the existence of the Japanese monopoly in natural camphor, and the competition of the synthetic product, the Committee came to the conclusion that the cultivation of camphor trees for commercial purposes in any part of the Empire should not be recommended at present.

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### *PASPALUM CONJUGATUM* GRASS FROM BRITISH HONDURAS

THE sample of grass which is the subject of this report was received at the Imperial Institute in April 1928, from the Conservator of Forests, British Honduras.

A fruiting specimen of the grass was also forwarded and was identified at the Royal Botanic Gardens, Kew, as *Paspalum conjugatum* Berg.

It was stated that the grass had been observed invading the cleared area of a mahogany camp in the South Stann Creek valley some 20 miles from the coast, and that it appeared to be much appreciated by cattle. It was desired to ascertain the suitability of the grass as a fodder with a view to its possible cultivation in the area in question, which consists of rich alluvial land and might afford scope for extensive development as pasture.

The sample consisted of the dried grass. The stems were flattened and ribbed and the leaves were about  $\frac{1}{2}$  in. in width at the base.

The grass was analysed with the following results, which are shown in comparison with corresponding figures recorded for *Paspalum conjugatum* from Java :

	Present sample.	<i>Paspalum conjugatum</i> from Java.
	Per cent.	Per cent.
Moisture . . . . .	8.8	16.5
Crude proteins . . . . .	6.6	5.6
Fat . . . . .	1.5	3.4
Carbohydrates, etc. (by difference) . . . . .	45.8	42.1
Crude fibre . . . . .	27.7	23.6
Ash . . . . .	9.6	8.8
Nutrient ratio . . . . .	1 : 7.5	1 : 8.9
Food units . . . . .	.66	.65

The grass was found to be free from alkaloids.

From these results it will be seen that the present sample is similar in composition to *Paspalum conjugatum* from Java. In comparison with the tropical grasses commonly used as fodders it contains a satisfactory amount of proteins and a normal percentage of crude fibre.

*Paspalum conjugatum* Berg. is stated to occur in tropical America and the West Indies, and also in Ceylon, Malaya, the East Indies and West Africa. It is known in Jamaica as "sour grass" and in Singapore as "green grass." It is appreciated on account of its rapid growth and power of withstanding drought, and its value as a fodder for horses and cattle. It has been stated that in cool climates the grass is bitter, but that in warm climates it is sweet, soft, and very readily eaten by animals.

It may be mentioned that an allied species, *P. dilatatum*, is cultivated as permanent pasture in New Zealand and elsewhere and is regarded as a valuable fodder. This species is recorded as containing about 6 per cent. of proteins and 33 per cent. of fibre, in material containing 5.72 per cent. of moisture. The composition of the present grass from British Honduras compares favourably with these figures.

In view of the use which is made of *Paspalum conjugatum* as a fodder in other countries, there would appear to be no reason why the grass should not be cultivated for this purpose in British Honduras.

## SEAWEED FROM SEYCHELLES

THE sample of seaweed which is the subject of this report was received for examination at the Imperial Institute in May 1927 from the Director of Agriculture, Seychelles.

The sample, which had been received from Mahé and had been prepared under the direction of Mr. James Hornell, consisted of small branched pieces of dried seaweed varying in length up to about 3 cm. and about 1 mm. in diameter. The material was mostly of pale brown colour, but some parts were white.

A portion of the seaweed was forwarded for identification to the Natural History Museum, and was pronounced to be a bleached specimen of *Gracilaria Wrightii* J. Ag., var. *ceylanica* Grun.

On examination the material furnished the following results :

	Per cent.
Moisture . . . . .	15.8
Crude Proteins . . . . .	9.4
Ether Extract . . . . .	1.1
Fibre . . . . .	10.6
Ash . . . . .	5.8*
Nitrogen-free Extract . . . . .	57.3

\* Containing silica equivalent to 0.6 per cent. of the weight of the seaweed.

Arsenic was found to be present in the seaweed to the extent of 0.00008 per cent. or 0.8 parts per million (equivalent to 1/180th grain of arsenic per lb.).

These results indicate that the seaweed contains an amount of crude proteins similar to the average quantity present in the algæ used for the preparation of agar agar and to that in Irish or Carrageen moss (*Chondrus crispus*). The percentages of ash constituents and fibre are also satisfactory. The amount of arsenic in the seaweed is practically identical with that which has been recorded by Tassilly and Leroide (*Analyst*, 1911, **36**, 218) in the case of Irish moss, and is much lower than that found in a specimen of the same material by Jones (*Pharmaceutical Journal*, 1922, **55**, 86), namely, 7 parts per million. Agar agar is stated to contain a similar amount of arsenic, viz. up to 1 part per million. The quantity of arsenic present in this seaweed from Seychelles may be regarded as so small as to be generally unobjectionable.

When treated with cold water for some hours the seaweed swells somewhat and becomes almost white and semi-translucent. The quantity of matter extracted by the cold water was found to amount to 3.0 per cent.

On boiling the seaweed repeatedly with hot water 63.0 per cent. was extracted. This experiment involved about 20 separate boilings and extended over several days. At the end of that time it was found that small quantities could still be extracted.

A series of experiments was made in which the seaweed was boiled for 30 minutes with water and the solution allowed to cool, and it was found that when one part of seaweed was boiled with 400 parts of water the solution would just set to a jelly, and that a good firm jelly was obtained when one part of the seaweed was boiled with 100 parts of water. This compares favourably with prepared agar agar which furnishes a good firm jelly when one part of the material is boiled with 100 parts of water.

With a view to ascertaining the commercial value of the seaweed, a sample was forwarded to a firm of merchants who regarded it as an attractive material and considered that it should be saleable if it could be placed on the market at a reasonable price. They were of opinion that the seaweed would be equal, if not superior, to the finest grades of Irish moss. The firm stated that it was difficult for them to suggest the actual value as the material would have to be introduced to manufacturers in this country, but added that if they could be informed as to the lowest price, freight paid to United Kingdom port, at which a trial shipment of one or two tons could be forwarded, they would be glad to consider the importation of such a consignment with a view to testing the market.

The results of this investigation have shown that this *Gracilaria* seaweed from Seychelles is of good quality and comparable with the best grades of Irish moss, but that as the material is not at present known to manufacturers it would be necessary to forward a trial consignment in order to test the market. It has been pointed out to the Seychelles authorities, however, that in the first place, information should be supplied as suggested by the merchants consulted, as to the lowest price at which the seaweed could be remuneratively offered in this country.

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## ARTICLES

THE PUBLIC EXHIBITION GALLERIES OF THE  
IMPERIAL INSTITUTE

THE Public Exhibition Galleries, with their collections of Dominion, Colonial and Indian products, were brought into being as a result of clauses 1 and 2 of the Royal Charter granted to the Imperial Institute at its inception in 1887. These clauses specified :

1. " The formation and exhibition of collections representing the important raw materials and manufactured products of the Empire and of other countries, so maintained as to illustrate the development of agricultural, commercial and industrial progress in the Empire, and the comparative advances made in other countries."

2. " The establishment or promotion of commercial museums, sample rooms and intelligence offices, in London and other parts of the Empire."

The Exhibition Galleries were divided geographically into Courts, each devoted to a particular country, and exhibits to illustrate the natural resources and commercial products were arranged in each. In course of time there was accumulated a large but heterogeneous collection, the component parts of which had an individual interest, but which, as a whole, conveyed no clearly defined message. The commercial man, interested in one particular product, was only able to study his subject by visits to several separate Courts ; whilst the general public were unable to grasp the salient facts concerning any one country, because the main exhibits were interspersed with others of a purely technical nature, the whole being crowded in an unattractive manner.

In May 1925, the passing of the Imperial Institute Act opened a new chapter in the life of the Institute, the main purpose of the Exhibition Galleries being changed to that of public information and instruction. This change permitted the withdrawal of large numbers of exhibits, of



PLATE I —THE EAST AFRICAN COURT

An example of a rearranged Court showing wide spacing and a definite grouping of exhibits (not shown) are fixed the transparencies referred to in the article



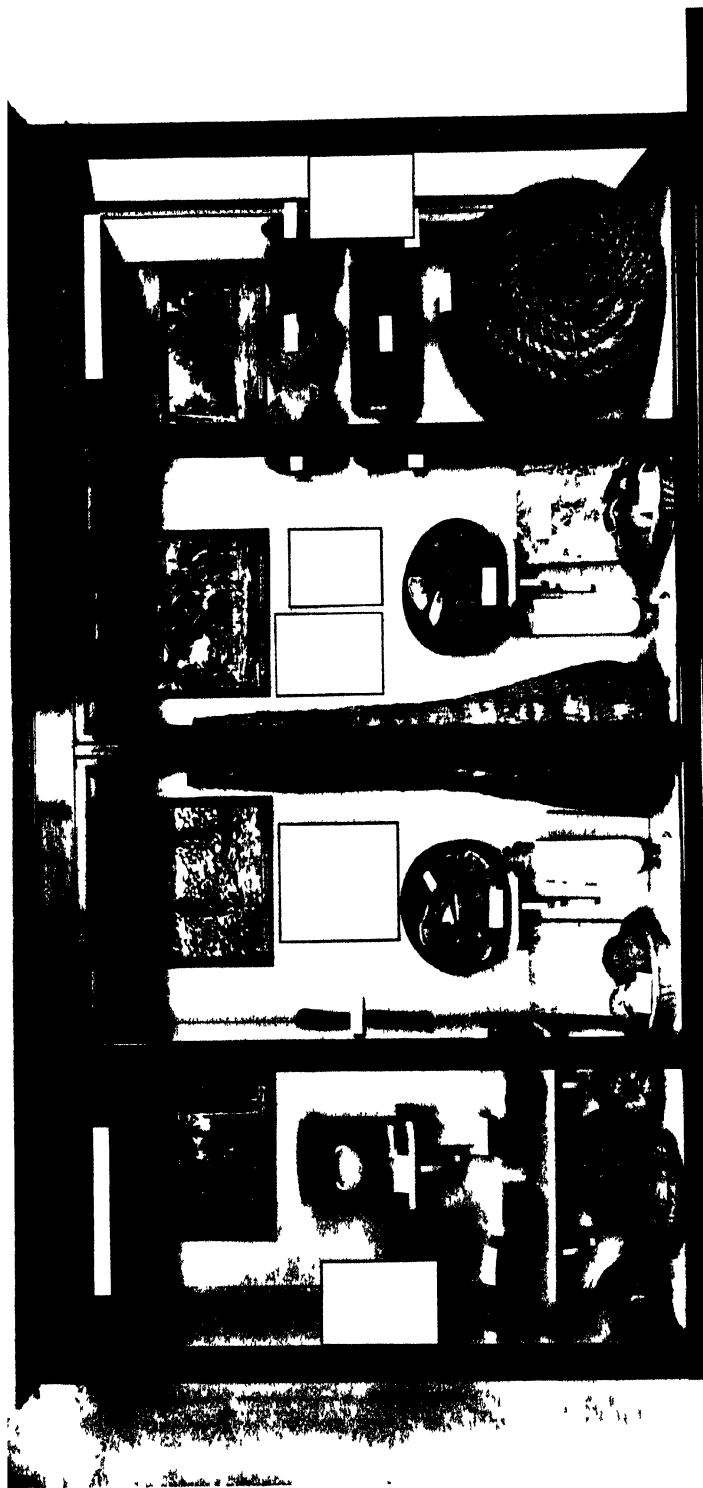


PLATE II — A SHOW-CASE IN THE EAST AFRICAN COURT

This exhibit illustrates the Coconut Industry and shows the method of displaying the raw material, some of the manufactured products and photographs of the cultivation and preparation of the product

little or no interest to the general public. The spaces so released allowed of a more spacious and attractive method of display, and the resultant necessary reorganisation permitted the carrying out of new schemes of lighting, heating and redecoration.

Under the new scheme of arrangement, suggested by the Imperial Institute Advisory Education Committee, convened for that purpose, the geographical system of Courts has been retained, but the general lay-out of each Court is made to conform, as far as possible, with modern methods of teaching economic geography and Empire development. The manner in which this result has been attained may be seen by the examination of a typical Court. At the entrance is a descriptive label giving a few salient facts concerning the world position of the country concerned; its area, main physical features and climatic conditions; its people and their industrial activities; together with maps and charts which emphasise these facts. Dioramas illustrating some important feature of scenery, sport or industry are placed in key positions, and around them, spaced so as to permit of the easy passage of visitors, are modern show-cases of a type suitable for the adequate and attractive display of their contents. The exhibits illustrate, in sequence, the ethnology, the mineralogy, the forestry and forest products, the fisheries, the agriculture and manufacturing industries of the particular country. Whenever possible photographs are employed, either on the walls or in swing frames, to illustrate aspects which cannot be shown by specimens, such as scenery, native types, wild life and vegetation, whilst in the windows are enlarged photographic transparencies giving the more striking local features (see Plate I). Returning to the show-cases, each exhibit is, where possible, arranged to illustrate progressive stages in the production or manufacture of a commodity, and is made to tell its own story. Attractiveness of display is the keynote: the primary appeal being made "to the eye," so that the casual visitor subconsciously carries away with him certain definite impressions. Should this primary appeal succeed in interesting the visitor, the lay-out of each show-case affords an opportunity for him to obtain

further, and more detailed, information. Printed descriptive labels in clear, non-technical language are attached to each exhibit; whilst simple charts of production and "flow sheets" show how the products are derived and their ultimate utilisation in industry. In addition to the samples mentioned, photographs of scenes in the field where the product is produced, or in the factory where it is utilised, link the whole together (see Plate II). In this way, without conscious effort, the visitor acquires some knowledge of what the Empire produces, and of the importance of the materials to the Colony concerned and to the Mother Country.

In pursuing the scheme of visual instruction, the diorama, or illuminated picture model, has proved of real value. As a focal point, it serves to call attention to other somewhat less attractive exhibits grouped around, whilst in itself it conveys impressions which could be obtained in no other manner, except by an actual visit to the scene or country which it illustrates. In short, the diorama is a subtle combination of picture and model which presents, in miniature, a scene just as it would appear to the eye of the observer on the spot. By a clever system of perspective and careful illumination, the contour of the country, the modelling of the objects in the foreground, even the atmosphere, are conveyed in a manner which leaves little to the imagination. In spite of their admitted utility the installation of one or more dioramas in each Court is a slow process, due principally to the amount of time and care which must be expended on them to obtain realism. A studio has been provided at the Imperial Institute where several artists are constantly employed in constructing these dioramas; the structural work of the carcasses and final casing being carried out in the Imperial Institute workshops. The general method of construction is as follows: the subject of the diorama having been decided on, it is necessary that the artist should become thoroughly familiar with all its details. To this end the latest information on the subject is made available for his use, photographs and other data of every phase are obtained, and then a preliminary sketch is made. When this sketch has been examined by experts



PLATE III —DIORAMA OF A MANGANESE MINE, GOLD COAST

This illustrates the use of the diorama for displaying Empire industries. In this case the hill of manganese ore is shown together with the methods of working and the mechanical appliances for handling, preparing and transporting the ore.

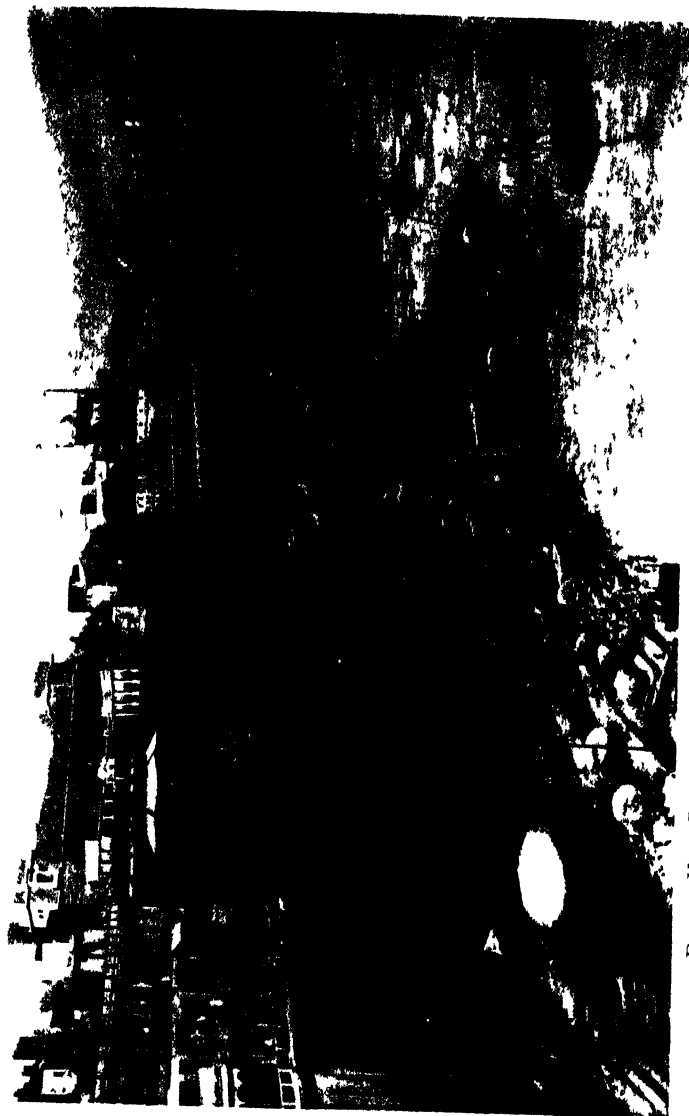


PLATE IV —DIORAMA OF THE BATHING AND BURNING GHATS, BENARES

This illustrates the use of the diorama for scenic displays to illustrate the life of the people in Empire countries. It shows the more important buildings on the river banks of the Ganges with pilgrims, bathing and performing other religious rites.

and passed, the diorama proper is commenced. Starting as a carcase of wood and beaverboard, it is gradually evolved from back to front. First the background is painted in; then the middle distance is modelled and coloured; and finally the figures, miniature buildings and trees, fences, railways, boats, or other objects of the foreground are constructed and placed in position. Among the various materials used are wood, plaster, "marbolith," plastic wood, sawdust, seccotine, wire, sheet metal, putty, cotton wool, string, rag, paper, and of course paint. At each stage, every detail is carefully compared with photographs, and the criticism of planters, engineers, travellers and local government officials with expert knowledge of the country or subject being treated, is invited and utilised. After being finally scrutinised by such experts, and passed by them as a faithful representation of the scene that it is intended to portray, it takes its allotted position in the Galleries. Under the most favourable circumstances a diorama will take some six or seven weeks to complete; or when special photographs have to be obtained it may take as many months (see Plates III and IV).

Another factor which tends materially to render the installation of a representative set of dioramas a slow process is the expense which they involve. The necessary funds are, however, coming gradually to hand, and it is to be hoped, in due course, to complete the series proposed.

Up to the present thirty-two dioramas have been placed on exhibition. Among the most recent additions provided out of special grants by the respective Governments are the following:

In the British Malaya Court—"A Tin Mine," "A Tin Dredge" and "A Malayan Village"; in the Southern Rhodesia Court—"A Rhodesian Tobacco Plantation" and "The Victoria Falls"; in the Sudan Court—"Cotton Cultivation on the Gezira Plain"; and in the Gold Coast Court—"A Manganese Mine."

Several commercial firms and associations have shown their interest in the Exhibition Galleries by providing

funds for the construction of dioramas. The following are instances of dioramas which have been, or are being, constructed in the Imperial Institute studio from funds generously furnished by private donors.

"The Oil Palm Industry, Nigeria," and "The Copra Industry in the Solomon Islands," presented by Messrs. Lever Brothers.

"The Indian Tea Industry," presented by The Indian Tea Association.

"The Indian Lac Industry," presented by the Indian Lac Association.

Four views of, respectively, "The Taj Mahal," "Udai-pur," "Kashmir" and "Benares," presented by the Indian State Railways.

Two scenes on a Malayan rubber estate, presented by the Rubber Growers' Association.

"The Prince of Wales's Ranch in Alberta," "Quebec Harbour," "A Scene near Banff" and "A Harvest Scene," presented by the Canadian Pacific Railway.

"Freetown Harbour," presented by Messrs. Elder Dempster.

"A Scene in a Burmese Teak Forest," presented by Messrs. Steel Brothers.

"Ginger Industry, Sierra Leone," presented by Messrs. Paterson Zochonis.

"Ceylon Graphite Industry," presented by N. D. S. Silva, Esq., O.B.E., Member of the Ceylon Legislative Council.

Another feature which has proved to be of service in illustrating the physical geography of a country is the relief model or contour relief map. In these the physical characters are graphically shown, and in this way the connection between the country and its products and industries is more readily seen. These models are constructed at the Imperial Institute studio in "marbolith," a material which allows of easy manipulation during modelling, but which in a few hours sets into a solid mass. So far examples of these models have been

installed in the New Zealand and British Malaya Courts.

It had long been realised by the authorities of the Imperial Institute that the provision of a cinema in the Exhibition Galleries would be of great value for instructional purposes, but, unfortunately, funds to meet the heavy expense involved in the conversion of a suitable hall, and the installation of the necessary apparatus, were not forthcoming. In 1927, however, the Empire Marketing Board generously agreed to place at the disposal of the Imperial Institute a sum sufficient to cover the cost of such an installation, and to meet the maintenance charge for a specified number of years. As a result of this grant an existing building was converted into a Cinema Hall, and, on July 1, 1927, it was opened as a model cinema, replete with every modern adjunct, and capable of seating about four hundred persons. That this new venture was an immediate success is shown by the attendance returns of the six months which followed, namely 135,545 persons. Since the opening of the cinema the average weekly attendance in the galleries has risen from 2,000 to nearly 6,000 and there is no doubt that the cinema is responsible for a good proportion of this increase. The daily programme consists of four sessions, each lasting an hour and a quarter on week days, and two similar sessions on Sunday afternoons. The programme is changed three times a week, and every effort is made to keep it as interesting and as varied as possible. The films shown illustrate the chief industries, the life and customs of the people, and the scenery of the overseas countries; also the manufacture in the home country of commodities utilising Empire raw products and other phases of Empire development. Films of this nature are of the utmost utility in supplementing the scheme of visual instruction adopted for the displays in the Courts. Of the six hundred films which are at present available, many are lent free of charge by official and commercial bodies, and the authorities of the Imperial Institute are greatly indebted to them for this generosity and co-operation. There are, however, still many gaps to be filled, some countries and industries being as yet unrepresented, and efforts are



being made to induce the governments concerned to make these films, primarily for their own use but also for the use of the Imperial Institute.

In addition to the exhibition of films of the nature above described, the cinema has recently been used for lantern lectures on overseas countries. This is a new departure, and the series already given on "Canada from Coast to Coast" has proved such a success that others on New Zealand and South Africa have been arranged, and it is hoped to include other countries in due course.

The cinema is also made available to other institutions for the display of special films and for lectures. For example, the Empire Marketing Board have made great use of the Hall for trying-out films connected with their work of publicity, and recently the film recording Captain Scott's expedition to the South Pole was exhibited by Mr. Herbert Ponting, the photographer to the expedition, the principal object being to interest English people in the preservation of this fine record for the Empire.

A Central Stand is maintained in the Exhibition Galleries for the receipt of enquiries, the sale of Imperial Institute publications, picture postcards, and for the distribution of free literature issued by Dominion and Colonial governments. Many thousand copies of free pamphlets are distributed from the stand to intending emigrants and tourists, and to students, school teachers and others who employ them for educational purposes.

With regard to the picture postcards, the repeated demand for illustrations dealing with the overseas countries and their products led the Imperial Institute to select for sale series of cards from publishers' supplies. These, however, did not deal with many of the important industrial aspects which visitors required and eight series of postcards have been specially prepared to meet this need. These illustrate the Coffee Industry in Kenya, the Tea and Coconut Industries in Ceylon, the Sugar Industry in Fiji, the Cocoa Industry in Trinidad, the Rubber Industry in Malaya and the Tea Industry in India. Leaflets

describing each of these industries and containing maps showing the areas of production have also been prepared. There is a steady demand for these postcards, and it is proposed to extend the series from time to time as material and funds become available.

Apart from the permanent exhibition in the Main Galleries, temporary displays in the Exhibition Pavilion have been inaugurated to indicate the possible utilisation of Empire raw materials in modern industry and commerce. Of this series, two have so far been held. In 1927 a rubber exhibition illustrating every phase in the cultivation and production of raw rubber, its manufacture, and its numerous uses in industry, hygiene, transport, sport and in the home, was staged in co-operation with the Rubber Growers' Association. In 1928 an exhibition of Empire Timbers was arranged which helped to direct attention to a number of timbers of Empire origin which could be used in industry to replace many of the foreign ones now employed. Both these exhibitions were well received and attended. The timber exhibition attracted much attention from architects, builders, furniture manufacturers and other users of timber, and as an example of its practical value, mention may be made of an order for 10,000 cubic feet of sawn Greenheart timber, which was given as a direct result of the inspection of a sawn log of timber in the British Guiana section of the exhibition.

Apart from their own value to commercial men in indicating the Empire sources of important raw materials, these temporary exhibitions are very useful for publicity purposes since visitors to them must pass through the main Exhibition Galleries. In this way the collections are brought to the notice of many people who might not otherwise have visited them.

In addition to the Exhibition Pavilion, a gallery, now known as the Imperial Gallery of Art, has, thanks to the generosity of the 1851 Exhibition Commissioners and Sir Joseph Duveen, Bart., been set aside for periodic exhibitions of the work of contemporary Empire artists.

Besides the work carried on at the Institute the

Exhibition Galleries are frequently called upon to furnish exhibits for important trade exhibitions. For example, at the Advertising Exhibition held at Olympia in 1927 a display of Rhodesian tobacco was made. At the British Industries Fair, 1928, a special exhibit illustrating the Empire's resources of tin was arranged. This exhibit included specimens of tin ore from all the Empire producing countries, and two dioramas showing the methods of tin-mining practised in Malaya. Four other dioramas were lent to the Empire Marketing Board for this exhibition. Dioramas have also been lent to the Empire Marketing Board for display at the Ideal Home Exhibition held at Olympia in 1928, and at the Toronto National Exhibition, 1928. At the Building Exhibition, held at Olympia 1928, a stand illustrating the work of the Imperial Institute in the examination of Empire building materials, such as timbers, cements and clays attracted considerable attention and led to many enquiries.

There is every reason to believe that this external work will increase in the future, and that it will materially assist in making the Imperial Institute and its work better known to the hundreds of thousands of the general public who visit these exhibitions.

The main purpose of the Exhibition Galleries being that of public information and instruction, the greatest measure of success will undoubtedly be encountered in dealing with the younger generation. It is for this reason that close co-operation is maintained with the various educational authorities, and the schools which they control. The Exhibition Galleries have become recognised by these authorities as of definite value in the teaching of Empire geography and commerce, and regular visits to them now form part of the normal curriculum of those schools within easy reach. To make such visits of the greatest possible value to the scholars, two guide lecturers are available for lecture demonstrations in the Courts, while each autumn special conducted tours are arranged for those teachers who wish to conduct their own classes and to impart the information gained in a manner suited to the age and standard of education of the children. That full

advantage is taken of these facilities is shown by the average weekly attendance, during the first six months of this year, of 65 school parties, comprising over 1,500 scholars. Similar tours have been arranged from time to time for parties from institutions such as the Grocers' Institute, the Textile Institute, the Brigade of Guards Educational Corps, and so on.

In addition to tours of the Galleries, parties can also reserve seating accommodation in the cinema for any definite session on making previous written application. In order that visits may be made at a time when the required subjects are being shown, the current programme is published each month in the *London County Council Gazette* and other educational journals; and copies, together with the particulars of the other facilities, are periodically circulated to all schools in the London, Middlesex and adjoining areas. School authorities are, however, warned that the cinema should not be the sole object of the visit, but should be preceded or followed by visits to the Courts or to lectures.

To extend still further the facilities offered by the Exhibition Galleries, small samples of the more important products on view may be obtained by teachers for school museums. These samples are drawn from surplus material, and the variety available naturally varies from time to time. The current list of products may be obtained on written application and the samples selected are supplied at the nominal charge of 1d. each specimen, plus the cost of carriage.

By these various services specially devised for schools and by the ease with which the latter can be circularised, the Exhibition Galleries have become well known to the educational authorities in London, and to thousands of children. Much assistance in making known the Galleries to the general public has been afforded by the Press notices on matters of topical interest at the Imperial Institute, for which assistance the authorities are duly grateful. The special poster generously prepared and exhibited at its stations by the Underground Electric Railways Limited has also greatly helped in this work, but no adequate scheme of publicity by the Imperial

Institute authorities is possible owing to the lack of funds.

The manner in which a more attractive, and, at the same time, a more educational exhibition is being evolved from the old Colonial and Indian Collections has already been shown. Much reorganisation, however, still remains to be done. Many of the Courts are far more advanced towards completion than others, owing to the enthusiastic manner in which some governments and private firms with Colonial interests have responded with money and materials. The following Courts have been, or are being, reorganised as a result of special grants for this purpose from the respective Governments: New Zealand, British Malaya, East Africa, Bermuda, West Indies, Sierra Leone, Gold Coast, Nigeria, Fiji, Solomon Islands, Sudan, Seychelles, Southern Rhodesia, Newfoundland, Cyprus. But even with these, the displays can never be considered finished or permanent. Owing to the nature of much of the material, it soon deteriorates, and photographs of industries soon become out-of-date and require renewal. As new industries spring up or old ones develop, they should be given due prominence in the Courts of the Exhibition Galleries, hence the necessity for maintaining close touch with the Colonial governments and their technical officers, and for the inauguration of a definite service by means of which the necessary records of industrial progress and the supplies of materials and photographs for their illustration will be collected and forwarded at regular intervals. The authorities of the Imperial Institute are always pleased to meet any officials or residents from the overseas countries who may be visiting this country and to receive their helpful criticism and advice concerning the Courts of the countries they represent, as only by their whole-hearted co-operation can the Exhibition Galleries hope to fulfil their functions and fully realise their possibilities.

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## TANNING MATERIALS OF THE BRITISH EMPIRE

## PART IV

IN this, the concluding part of this article, a number of lesser-known tanning materials are dealt with, which are not at present in commerce but which appear to be worthy of consideration either from the point of view of export or of local utilisation. It has not been possible, owing to limitations of space, to deal with many comparatively unimportant materials which have been investigated in various parts of the Empire, but the reader will find particulars of a number of such materials in the following publications :

"Indian Tanstuffs and their Tannage." By W. A. Fraymouth and J. A. Pilgrim. *Bull. No. 1, 1918, Esociet Tanning Research Factory, Maihar, C.P.* (Calcutta : Superintendent, Government Printing, 1918.)

"Indian Tanstuffs." By J. A. Pilgrim. *Government of India, Board of Industries and Munitions.* (Calcutta : Superintendent, Government Printing, 1920.)

"A Survey of the Tanning Materials of Australia." By D. Coghill. *Bull. No. 32, Council for Scientific and Industrial Research, Australia.* (Melbourne : Government Printer, 1927.)

"The Principal Tanning Materials of Australia and their Leather Forming Properties." By M. B. Welch and F. A. Coombs. *Bull. No. 10, Technological Museum, Sydney.* (Sydney : Government Printer, 1926.)

"A Tannin Survey of South Australia." *Report No. 6, Advisory Council of Science and Industry of South Australia*, pp. 23-57. (Secretary to the Council, Department of Chemistry, Adelaide, 1924.)

"Notes on the Tannin Resources of Western Australia." By S. L. Kessell. *Bull. No. 3, Forestry Department, Western Australia.* (Perth : Government Printer, 1923.)

"The Indigenous Tans and Vegetable Dyestuffs of New Zealand." By B. C. Aston. *New Zealand Journal of Agriculture*, vol. xv, August 1917, pp. 55-62 ; vol. xv, September 1917, pp. 117-128 ; vol. xvi, June 1918, pp.

358-365 ; vol. xvii, September 1918, pp. 136-139 ; vol. xxii, February 1921, pp. 100-101.

A number of reports on miscellaneous materials from various countries have also been published in this BULLETIN, among which may be mentioned the following : Vol. IV (1906), No. 2, pp. 95-97 (Sudan) ; Vol. V (1907), No. 4, pp. 354-360 (Uganda, Somaliland and Sudan) ; Vol. IX (1913), No. 3, pp. 412-426 (Sudan, Cyprus, Nigeria, Hong Kong, Tasmania, Ceylon) ; and Vol. XXIII (1925), No. 2, pp. 158-168 (Travancore, India).

For convenience of reference an index is given at the end of this part to all the tanning materials dealt with in the four parts of this article ; an index to the countries referred to is also included.

**Anaphrenium argenteum** E. Mey. (= *Rhus Thunbergii* Hook.). Kliphout. Anacardiaceæ.

This tree occurs in certain parts of the Cape Province, South Africa, principally in the Cedarberg Mountains. The bark contains a high percentage of tannin, and has been employed to some extent by local tanners for use in conjunction with wattle bark, which counteracts the tendency of Kliphout to produce a slight brittleness in the leather. An analysis of the bark at the Imperial Institute showed it to contain 33 per cent. of tannin, and analysis carried out at the Cedara laboratory indicated the presence of 34.2 per cent. of tannin in the bark, and 4.8 per cent. in the leaves and twigs.

**Anogeissus latifolia** Wall. Dhawa. Combretaceæ.

This is a large deciduous Indian tree met with in the Sub-Himalayan tract from the Ravi eastward to Central and Southern India. The leaves and twigs of this tree, which is the principal source of commercial "Ghatti" gum, have been employed for many years in Indian tanneries under the name of "Country Sumac." The dry mature leaves of the tree contain about 16 per cent. of tannin, whereas the dry, reddish tips of young leaves have been shown to contain up to 55 per cent. of tannin. Experiments in India have demonstrated that pollarded

trees will furnish yearly three crops, consisting of a mixture of green leaves, red leaves and petioles, which, when dried and coarsely ground to pass a ten-mesh sieve, yield a product containing 30 per cent. of tannin and 16 per cent. of soluble non-tannins. The tannin penetrates rapidly and produces a satisfactory pale-coloured leather having a greenish tinge. The dry bark of *A. latifolia* contains from about 10 to 15 per cent. of tannin, and gives excellent results in combination with avaram (*Cassia auriculata* bark).

**Callitris spp.** Australian pine barks, Cypress pines.  
Coniferæ.

The barks of several species of *Callitris* have been shown to contain appreciable amounts of tannin; the most important is that of *C. calcarata* R. Br., Black Pine, which contains from about 10 to 36 per cent. of tannin, and on an average from 20 to 25 per cent., with a low percentage of soluble non-tannins (see this BULLETIN, 1926, 24, 702). This species is an evergreen tree reaching a height of almost 100 ft. It is very widely distributed throughout Queensland, New South Wales, and Victoria. Used alone the bark furnishes a red leather, having properties somewhat similar to those produced by hemlock bark, and inclined to be harsh but more water-resisting than wattle-tanned leather. *C. calcarata* bark gives good weight, and forms a most satisfactory sole-leather tannage when used in admixture with wattle. This bark has not been used to any great extent in Australian tanneries owing largely to supplies of the more valuable wattle bark being available. Experiments have indicated that the bark would be especially suitable for the manufacture of extract, but it seems doubtful whether it could be obtained in sufficient quantity in any one place to permit of an extract plant being profitably operated; success would therefore depend on the provision of ample transport facilities.

*C. glauca* R. Br., White Pine, next in importance to *C. calcarata*, is even more widely distributed throughout Australia, occurring in all the States with the exception of



Tasmania. Published analyses of the air-dried bark show the tannin content to be from about 9 to 23 per cent. with a low percentage of soluble non-tannins. As this bark contains a comparatively small amount of tannin, its value would depend on its utilisation for the manufacture of extract. The tannage is similar to that of *C. calcarata*.

***Carissa spinarum* A. DC. Karunda. Apocynaceæ.**

A wild, thorny, evergreen shrub, which occurs in most parts of India and in large areas throughout the Central and Northern parts of that country. According to Pilgrim, the dry mature leaves contain about 11 per cent. of tannin and 24 per cent. of soluble non-tannins. The bush coppices well, and it is possible to collect the leaves all the year round. The tannage is slow, causing extreme swelling of the hide, and if care is not taken "drawing" of the grain takes place. With admixture of other Indian tanstuffs very satisfactory results are obtained. The twig bark of *Phyllanthus Emblica* (q.v.), for instance, has been found to be an ideal ingredient, as its red effect neutralises the greenish colouration produced by *C. spinarum* leaves.

***Colpoon compressum* Berg. (= *Osyris compressa* A.DC.) Cape Sumach. Santalaceæ.**

The leaves and stems of this South African plant, although known as Cape Sumach, possess quite different tanning properties from those of true sumach (*Rhus coriaria*). The tannin is of the catechol class, and the leather produced is stated to be spongy and porous. Cape Sumach may contain as much as 26 per cent. of tannin, though a sample examined at the Imperial Institute contained only 11 per cent.; the average is probably about 17 per cent. This material is hardly likely to be of importance for other than local use.

***Elephantorrhiza Burchellii* Benth. Elands Boontjes. Leguminosæ.**

The roots of this shrub, which occurs in most parts of South Africa, are several feet long, about 2 in. in diameter

and contain a fair amount of tannin. The air-dried roots, with a moisture content of 10 per cent., contain about 17 per cent. of tannin, but the soluble non-tannin matter is undesirably high, viz. about 23 per cent. The roots produce a soft but fairly tough leather, but owing to the objectionable deep red colour of the infusion the material cannot be used in the production of a leather of good quality. At one time it was largely used in local tanning, and is still preferred for certain uses. The material is not sufficiently rich in tannin for export purposes, and in view of the excessive amount of soluble non-tannins present it would not be suitable for the production of extract. The available supplies moreover are not sufficient for the establishment of an overseas trade, and the material is not of such value as to warrant the cultivation of the plant.

**Eucalyptus alba** Reinw. Ridge gum of the Kimberleys, North-West Australia ; Poplar gum of tropical Queensland. Myrtaceæ.

This species is widely distributed, not only in tropical Australia, but also in the Eastern Archipelago. In Australia it is confined mostly to tropical regions, extending over the north from Queensland to the Kimberleys and North-West Australia generally.

There is a great difference between the amount of tannin in the bark of trees grown in the Kimberleys and that in the bark from Queensland, the average content of the former being 30 per cent., and of the latter only 7 per cent. The ratio of tannin to non-tannins in the Kimberleys bark varies from 2 : 1 to 3 : 1. The bark contains kino, which probably constitutes the main part, if not all, of the tannins. Small-scale tanning trials with the bark from the Kimberleys have indicated that it is likely to prove a valuable tanning material. Adequate supplies are believed to exist. Leather prepared from ridge gum tannins is light-coloured and in the crust state is comparable in colour with such tannages as sumach and is superior to wattle. It is suggested that this material might advantageously be employed blended with wattle or mangrove bark.

The wood, leaves and twigs of this tree grown in both Western Australia and Queensland contain fair quantities of tannin, but the percentage of non-tannins, being in many cases, nearly, if not quite, as high as that of the tannins, would render these parts of the tree unsuitable for extract manufacture.

Ridge gum bark is a promising tanning material and, if ample supplies are available, it could be utilised for the preparation of a tannin extract. It is understood that the Western Australian Government may take steps to have the area examined and the available supplies ascertained.

***Eucalyptus calophylla* R. Br.** Red-gum or Marri.

This tree occurs with jarrah (*E. marginata* Sm.) and karri (*E. diversicolor* F. Muell.) in the extreme south-west of Western Australia. The principal form of the raw material to be used for tanning purposes would be the kino-impregnated bark. This material could be collected in large quantities, the supplies being almost unlimited. The tannin content of the kino is high, whereas the bark and wood when free from visible kino contain only a small amount of tannin. The kino exhibits two features undesirable in tanning materials, viz. its insolubility in water and its deep red colour. The former has been overcome by treatment with alkaline sulphites under pressure in an autoclave, when a small loss in tannin and a slight increase in non-tannins and insolubles result. It is stated that sulphited or soluble marri kino might replace the quebracho extract in use in Australian tanneries. The use of precipitants, such as aluminium sulphate, for the reduction of the high colour is not recommended. It is preferable to overcome this disadvantage by blending the soluble marri kino with lighter coloured materials, e.g. extracts prepared from karri (*E. diversicolor*) and tuart wood (*E. gomphocephala* DC.). Wattle bark might also be used for this purpose. Marri kino contains from 57 to 69 per cent. of tannin and 9 to 11 per cent. of non-tannins. Laboratory tanning trials with sulphited marri kino have given promising results.

**Eucalyptus diversicolor** F. Muell. Karri.

This species is confined to Western Australia and occurs in dense forest in the extreme south-west corner of the State. The wood is low in tannin. The bark is regularly available in large quantities from logging and milling operations and could be collected cheaply. The tannin content of the bark varies from 11 to 22 per cent. and the non-tannins from 5 to 11 per cent. Karri bark extracts are light-coloured, and in laboratory-scale tanning tests have produced leather of favourable colour. The bark can be considered a suitable raw material for the manufacture of a good tannin extract. A cheap and useful tanning material can also be produced from this bark by blending it with sulphited marri kino (*E. calophylla*)

**Eucalyptus gomphocephala** DC. Tuart.

This species is confined to Western Australia, where it forms a fairly dense forest along the coast line south of Perth. The timber is commercially exploited. The bark is relatively poor in tannin, containing up to about 6 per cent. The wood is considerably richer in tannin, and it is suggested that the waste material from the saw-mills could be successfully utilised for the manufacture of extract. These waste products contain up to 10 per cent. of tannin, while the ratio of tannins to non-tannins is about 3 to 1. It is suggested that tuart wood extract might also be blended with sulphited marri kino (*E. calophylla*) to produce a useful product.

**Phyllanthus Emblica**, Linn. Aoula. Euphorbiaceæ.

A moderate-sized deciduous tree, found almost throughout India and Burma. The bark, leaves and fruit of this tree have long been employed by natives in India for tanning. Pilgrim has shown that whereas the dry bole bark contains on the average only about 8 to 9 per cent. of tannin, the dry twig bark contains as much as 24 per cent., together with about 17 per cent. of soluble non-tannins. The dry leaves contain from 23 to 28 per cent. of tannin, and the dried full-grown unripe fruits may contain 35 per cent. of tannin. *P. Emblica* bark produces a

very smooth-grained, reddish leather, with a steady swelling of the hide during tanning. A sample of *P. Emblica* leaves (air-dried) from Hong Kong, examined at the Imperial Institute, contained 16.8 per cent. of tannin and 11.9 per cent. of soluble non-tannins. It furnished a soft leather of firm texture, pale cream in colour, with a faint greenish-yellow tinge (this BULLETIN, 1913, 11, 426).

***Pinus halepensis* Mill.** Aleppo pine.

The bark of this species is an important tanning material on the Mediterranean coasts. The outer bark contains about 15 per cent. of tannin, whereas the inner bark, which yields a paler-coloured tannin, contains up to about 25 per cent. A sample of air-dried bark from this species grown in South Australia, where it is stated to cover a small area, was found to contain 20.5 per cent. of tannin and 8.4 per cent. of soluble non-tannins.

***Pinus longifolia* Roxb.** Chir pine.

This species, which is the main source of Indian turpentine, furnishes bark containing from about 11 to 14 per cent. of tannin, and is used to some extent in native tanning.

***Pinus Khasya* Royle.** Burma Hill pine.

This pine, as the common name indicates, is found in the hills of Burma; it occurs also in the Shan States. Pilgrim, who has examined the tanning value of the bark of this tree, commends it as a valuable potential tanning material for medium and heavy leathers. Two samples of the bark examined by him contained about 7 and 10 per cent. of tannin (expressed on the dry material), with about half as much soluble non-tannins (*Indian Forest Bull.*, No. 57, 1923).

***Shorea robusta* Gaertn.** Sal. Dipterocarpaceæ.

A large gregarious tree best known for its timber. It occurs in India from the provinces of Bengal and Bihar to the foot of the Himalayas. In the production of timber large quantities of this bark become available, and it has

long been used successfully as a local tanning material. The bark contains from 3 to 9 per cent. of tannin, and furnishes a very tough, reddish-coloured leather. Experiments were carried out at the Imperial Institute some years ago in the preparation of a tannin extract from this bark, and a suitable process was devised for decolourising the extract. It was considered in India, however, that it would be more profitable to manufacture mangrove extract. The fully-grown dry leaves of the tree contain from 8 to 10 per cent. of tannin, and the dry young leaves with their twigs 23 per cent. A mixture composed of two parts of bark and one part of young leaves has been found to produce an excellent leather of pale colour, though the penetration is very slow.

**Terminalia Arjuna** Bedd. Kahua. Combretaceæ.

A large deciduous tree occurring on banks of rivers and streams throughout Central and Southern India, extending as far north as Oudh. The bark of this tree, which for many years has been employed to some extent by natives for dyeing and tanning, was first introduced to the tanneries of Cawnpore in 1915, and has since become a well-established and important Indian tannin-stuff. The dry bole bark contains from 20 to 24 per cent. of tannin, and the dry bark from the lower branches about 18 per cent. *T. Arjuna* bark tannage is capable of wide application, and can be used for the production of fine upper leather and excellent sole leather. The tannin, like that of oak bark, belongs to the pyrogallol and catechol class. The colour of the leather is a light brown, with no excessive red tint. The dry fruits of the tree, when green and nearly fully-grown, contain about 20 per cent. of tannin; it is said, however, that they do not produce good leather.

*Corrigenda.*—In Part III of this article reference was made (1927, 25, pp. 384 and 388) to the oaks and chestnuts of Burma. These trees have recently been submitted to a fresh botanical study and some of the names have been revised (*Burma Forest Bulletin*, No. 19, *Bot. Ser.*, No. 1, 1928). According to this revision *Quercus spicata* Sm. var.

*microcalyx* has proved to be *Q. polystachya* Wall. ; *Q. incana* Roxb. is really *Q. Kingiana* Craib, while the open-topped acorn variety of *Q. fenestrata* Roxb. is *Q. dealbata* Hook. fil. and Thoms. Two varieties of *Castanopsis tribuloides* A.DC. have been identified, viz., var. *ferox* King and var. *echidnocarpa* King. Possibly this may explain the difference in the tannin content of the barks grown at Namyas and Maymyo, referred to in the article.

### INDEX TO LATIN AND COMMON NAMES

The issues of the BULLETIN in which the four parts of the article have appeared are as follows :

I.=Vol. XXV (1927), No. 3.

II.=Vol. XXV (1927), No. 4.

III.=Vol. XXVI (1928), No. 1.

IV.=Present number.

- Acacia arabica* Willd , bark, I 285  
 — — —, pods III 35  
 — *Catechu* Willd , II 389  
 — *dealbata* Link, I 258  
 — *decurrens* var *mollis* Willd , I 253  
 — —, var *normalis*, I 258  
 — *mollissima* Willd (= *A. decurrens* var *mollis* Willd)  
 — *pycnantha* Benth , I 254  
 — *Suma* Kurz, II 389  
 — *Sundra* DC , II 389  
 Acorn cups, II 382  
 Algarobilla, III 33  
*Anaphrenum argenteum* E Mey , IV 312  
*Anogeissus latifolia* Wall , IV 312  
 Aoula, IV 317  
 Avaram bark, I 283  
*Avicennia nitida* Jacq , I 277  
 — *officinalis* Linn., I 271  
 Avla, I 283  
 Babul, bark, I 285  
 —, pods, III 35  
*Brugusera eriopetala* Wight and Arn., I 271  
 — *gymnorrhiza* Lam , I 270  
 — *parviflora* Wight and Arn , I 271  
 — *Rheedii* Blume, I 276  
*Cæsalpinia brevifolia* Baill , III 33  
 — *coriaria* Willd , III 31  
 — *digyna* Rottl , III 34  
*Callistris calcarata* R Br., IV 313  
 — *glauca* R Br., IV 313  
 Canaigre, III 37  
*Carapa moluccensis* Lam., I 270  
*Carissa spinarum* A DC , IV 314  
*Cassia auriculata* Linn , I 283  
*Castanea sativa* Mill , II 386  
 — *vesca* Gaertn (= *C sativa* Mill)  
*Castanopsis argyrophylla* Kurz, II 388  
 — *hystrix* A DC , II 387  
 — *indica* A DC II 387  
 — *tribuloides* A DC , II 387  
 — —, var *echidnocarpa* King, IV 320  
 — — —, var *ferox* King, IV 320  
*Ceriops Candolleana* Arn , I 270  
 — *Roxburghiana* Arn , I 270  
 — *Tagal* Robinson, I 270  
 Chestnut, Indian, II 387, IV 319  
 —, Spanish, II 386  
*Colpoon compressum* Berg , IV 314  
 Cutch, II 389  
 Cypress pine, IV 313  
 Dhawa, IV 312  
 Divi-divi, III 31  
 Dock, red or tanners', III 38  
 Elands Boontjes, IV 314  
*Elephantorrhiza Burchellii* Benth., IV 314  
*Eucalyptus alba* Reinw , IV 315  
 — *calophylla* R Br , IV 316  
 — *diversicolor* F Muell , IV 317  
 — *falcata* Turcz. var. *ecostata* Maiden, I 280  
 — *Gardneri* Maiden, I 280  
 — *gomphocephala* DC , IV 317  
 — *occidentalis* Endlich. var. *astrigens* Maiden, I 278

*Eucalyptus spathulata* Hook., I 280  
*Escocaria Agallocha* Linn., I 275

Gambia pods, III 35  
 Gambier, II 392  
 Gonakie pods, III 37  
 Gum, poplar, IV 315  
 — red, IV 316  
 —, ridge, IV 315

Hemlock bark, I 281  
*Heritiera Fomes* Buch.-Ham., I 274  
 — minor Roxb (= *H. Fomes* Buch.-Ham.)  
 — spp., I 271

Kahua, IV 319  
*Kandelia Rheedii* Wight and Arn., I 270  
 Karri, IV 317  
 Karunda, IV 314  
 Kino, IV 316  
 Kliphout, IV 312

Larch, Alpine, II, 385  
 —, European, II 385  
 —, Western, II, 385  
*Larix americana* Mich., II 385  
 — *europaea* DC., II 385  
 — *Griffithii* Hook f., II 385  
 — *Lyallii* Parl., II 385  
 — *occidentalis* Nutt., II 385

Mallet bark, I 278  
 —, blue, I 280  
 —, swamp, I 280  
 —, white, I 280  
 Mangrove bark, I 270  
 Marri kino, IV 316  
 Myrobalans, III 22.

Oak, American chestnut, II 382  
 — bark, II 380  
 — fruits (acorn cups), II 382  
 — leaves, II 382  
 — wood, II 382  
*Osyris compressa* A. DC. (= *Colpoos compressum* Berg.)

*Pomphis acidula* Forst., I 277  
*Phyllanthus Emblica* Linn., IV 317  
 Pine, Aleppo, IV 318  
 —, Australian, IV 313  
 — bark, IV 313  
 —, black, IV 313  
 —, Burma hill, IV 318  
 —, chir, IV 318  
 —, Cypress, IV 313  
 —, white, IV 313  
*Pinus halepensis* Mill., IV 318  
 — *Khasya* Royle, IV 318  
 — *longifolia* Roxb., IV 318  
*Pistacia Lentiscus* Linn., II 398

*Quercus Aegilops* Linn., II 382  
 — *Brandisiana* Kurz, II 384

*Quercus dealbata* Hook. fil. and Thoms, IV 320  
 — *dislatata* Lindl., II 384  
 — *fenestrata* Roxb., II 383; IV 320  
 — *Griffithii* Hook., II 384  
 — *incana* Roxb., II 383, IV 320  
 — *Kingiana* Craib, IV 320  
 — *lamellosa* Sm., II 384  
 — *Lindleyana* Wall., II 384  
 — *lineata* Blume, II 384  
 — *pachyphylla* Kurz., II 384  
 — *pedunculata* Ehrh., II 381  
 — *polystachya* Wall., IV 320  
 — *Prinus* Linn., II 382  
 — *semecarpifolia* Sm., II 384  
 — *serrata* Thunb., II 384  
 — *sessiliflora* Salisb., II 381  
 — *spicata* Sm. var. *microcalyx*, II 384; IV 319

*Rhizophora conjugata* Linn., I 271  
 — *Mangle* Linn., I 270  
 — *mucronata* Lam., I 270  
 Rhubarb, wild, III 38  
*Rhus Coriaria* Linn., II 396  
 — *Cotinus* Linn., II 402  
 — *glabra* Linn., II 403  
 — *Thunbergii* Hook. (= *Anaphrenium argenteum* E. Mey.)  
*Rumex hymenosepalus* Torr., III 37

Sal, IV 318  
 Sant pods, III 35  
*Shorea robusta* Gaertn., IV 318  
*Sonneratia apetala* Buch.-Ham., I 275  
 Sumach, II 396  
 —, Cape, IV 314  
 —, Turkish or Venetian, II 402

Tamarack, II 385  
 Teri pods, III 34  
*Terminalia Arjuna* Bedd., IV 319  
 — *Chebula* Retz., III 23  
 — *citrina* Fleming, III 25  
 — *pallida* Brandis, III 25  
 — *tomentella* Kurz, III 25  
 — *travancorensis* Wight and Arn., III 25  
*Tsuga canadensis* Carr., I 281  
 — *heterophylla* Carr., I 281  
 Tuart, IV 317  
 Turwad, I 283

*Uncaria Gambier* Roxb., II 392

Valonia, II 382

Wattle, black, I 253  
 —, golden, I 254  
 —, silver, I 258

*Xylocarpus granatum* Koen. (= *Carapa moluccensis* Lam.)

Yate, flat-topped, I 278



## INDEX TO COUNTRIES

Australia, I 258, 276, 278; II 402; III 31, 38; IV 312, 315-318	Jamaica, III 31
Bahamas, I 277	Kenya, I 264, 272
British East Africa, I 264, 267, 272; II 389; III 31	Mauritius, III 31
— Guiana, I 277	Nyasaland, I 269
— Honduras, I 277	Papua, I 276,
— North Borneo, I 273; II 396	Seychelles, I 270, 277
— West Africa, I 276; III 37	Sierra Leone, I 277
— West Indies, I 270; II 396; III 31	Straits Settlements, II 393
Canada, I 281; II 385	Sudan, III 35
Ceylon, I 269; II 396	Tanganyika, I 267, 272; III 31
Cyprus, II 396;	Union of South Africa, I 254; IV 312, 314
Federated Malay States, I 274; II 394	United Kingdom, II 380, 385
Fiji, I 277	Zanzibar, I 273
Gambia, I 277	
Gold Coast, I 277; III 31	
India, I 267; 274, 283, 285; II 383, 385, 387, 389, 402; III 22, 31, 34, 36, 38; IV 312, 314, 317-319	

## NOTES

**The Poisonous Properties of "Kiligi" Tuber from Tanganyika.—**

A specimen of the tuber of a plant, known to the natives of the Kondea-Irangi District, Tanganyika, as "Kiligi," was received for examination at the Imperial Institute in July 1927 from the Director of Agriculture. The exact identity of the plant was not stated, but it is considered to be a species of *Courbonia* (Natural Order Capparidaceæ). A copy of a letter from the Sub-Assistant Surgeon of the Government Hospital, Mkalama, stating that the tuber possesses poisonous properties and recording the symptoms produced, was furnished by the Director of Agriculture.

The tuber received weighed 1 lb. 11 oz. and was of irregular shape. The outer skin of the tuber was dry and fairly easily removable, while the interior was moist, firm and of a creamy white colour.

A portion of the tuber was peeled and the interior used for investigation. A preliminary test proved that no alkaloids were present.

It was found that on autolysis the material yielded 0.04 per cent. of hydrocyanic acid, expressed on the peeled tuber containing 82.1 per cent. of moisture, and equivalent to 0.22 per cent. on the moisture-free material.

The skin of the tuber was examined separately but furnished no hydrocyanic acid.

The results of this preliminary examination of the tuber have shown that it yields a large amount of hydrocyanic acid (probably present in the tuber in the form of a cyanogenetic glucoside), which would account for its poisonous properties. The degree of poisoning produced in a person consuming the tuber would depend on the treatment, if any, to which the tuber had been subjected before being eaten and the amount ingested.

The symptoms of poisoning described in the letter of the Sub-Assistant Surgeon of the Government Hospital, Mkalama, appear to be consistent with the view that they were caused by hydrocyanic acid.

**Madagascar Clove Industry.**—A study of this industry has recently been made by Mr. V. H. Kirkman, B.Sc., F.I.C., Director of Agriculture and Government Chemist, Zanzibar, who paid a visit to Madagascar in the early part of the present year on behalf of the Zanzibar Government. An account of his investigations has been issued officially as a "Memorandum upon the Position of the Clove Industry in Madagascar in 1928," from which the following notes are extracted.

The soil and climatic conditions of the Island are admirably adapted to clove cultivation. The absence of heavy rain during the harvesting period, October–December, is of special advantage as it enables the cloves to be obtained in a dry condition and of good colour, whereas in Zanzibar and Pemba the November rains render it very difficult to produce dry cloves and almost impossible to maintain them of a good colour throughout the season. On the other hand, the climate suffers from frequent cyclones, but this will not prevent the development of the industry, planters being advised to select sheltered positions wherever possible.

It is stated that about 25,000 acres in the Province of Tamatave have been planted with cloves during the past three years or so. Many of the young trees will probably perish from lack of attention, but there is no doubt that the industry is firmly established and will steadily increase in importance. It is considered that the natives have planted more trees than they will be able to harvest, the density of the population being only 22 per sq. mile as compared with about 200 per sq. mile in Zanzibar and Pemba. In general the cost of production in Madagascar is less than in Zanzibar, but whereas there is a tendency for costs to decrease in the latter country the opposite is the case in Madagascar.

Zanzibar and Pemba have an advantage in the com-

tractness of the area under cloves, and this has facilitated transport to an extent which would be impossible in such scattered cultivation as must necessarily obtain in a country like Madagascar, and has also rendered possible the association of the producers, thereby paving the way for improvement in the marketing of the crop.

In view of the economic importance of the question of the production of oil of cloves, the following statements on this subject from Mr. Kirkham's memorandum are reproduced verbatim.

"The distillation of essential oil from cloves, stems, and leaves, is a well-established branch of the industry, and one which has increased very greatly in recent years. During the year ending December 1926, 31 tons of oil were exported, and during nine months ending September 1927, 38 tons were exported, a rate of 50 tons a year. Cloves are less used than stems and leaves, and the latter are considered the more profitable, leaves being very cheaply gathered. I visited five distilleries and passed several others en route. Of the five inspected, one was owned by a company (*Société pour l'Industrie des Parfums*) which bought its raw material from native producers, one was owned by an Indian, two by French colonists, and one by a native, all of whom produced their own raw material, at any rate in a large part. The fuel problem is a difficulty for some, others are situated near forest land and have only the cost of cutting and hauling. The Indian informed us that wood-fuel was becoming scarcer, and that he paid 10s. a metric ton for it. He was, however, starting to utilise the fern scrub from uncultivated land.

"The cost of production varied greatly, and it was not always the case that the distillers had any idea of their own working costs; the highest cost of production was put down at 1s. 10d. per lb. of oil, and the lowest at less than a quarter of this. Leaf oil is sold locally at 2s. 6d. per lb. and stem oil at 2s. 9d. per lb.

"The mingled gratification and surprise shown when I informed distillers that distillation of cloves, stems, and leaves was prohibited in Zanzibar impressed me. I formed the opinion that they regarded distillation as an essential feature of the clove industry. In the neighbourhood of Tamatave there are—or rather were, for the cyclone of 1927 more or less destroyed them—plantations of young clove trees being raised specially for their leaves, just as the cinnamon is frequently grown. With the large amount of planting which has been done by the natives and the consequent shortage of labour and higher wages, it is

inevitable that the larger plantation owners will look more and more to the distillery as a way out of the difficulty. Ylang-ylang, cinnamon, lemon grass, etc., are attracting attention as side lines in the clove-growing areas, though the island of Nossi Bé is the great centre for ylang-ylang and other essential oils, and cloves are not grown there. There is an unmistakable expansion of the essential oil distillation industry taking place, and, with the large amount of clove leaf available, I consider that the distillation of cloves themselves, whether undertaken in England or elsewhere, is being threatened. English distillers will before long have to meet the competition of the cheaper clove leaf oil, and this will cause them to offer lower prices for cloves. It is fundamentally unsound to utilise the bud of the clove-tree for the preparation of eugenol if it can be more cheaply prepared from the leaves. Production from the leaves necessitates local distillation, and local distillation would encourage the production of other essential oil-bearing crops—in my opinion an important matter.

“If local distillation were permitted in Zanzibar it would be a help to producers and would enable distillers to operate in this country and compete on more than equal terms with the increasing number of leaf distillers in Madagascar. I say on more than equal terms because the concentration of our clove areas would enable large-scale operations to be carried out, impossible in Madagascar, and such operations would mean lower cost of production and a better-class article. The Madagascar oil, is, I was informed, re-distilled in France.”

In concluding his memorandum, Mr. Kirkham remarks that although the future output of cloves in Madagascar cannot be accurately foretold it is possible that 4,000 tons per annum may be produced within ten years. In view of this large increase in the world's production of cloves steps should be taken to increase the demand. Zanzibar should ensure her full share of the trade by improving the marketing organisation, and the producers must get the cost of production down to at least the level of the competing country. If these things are done, Zanzibar will be in the better position. There is plenty of room for a clove industry in Madagascar. World consumption is increasing, and the satisfactory supply of the commodity will stabilise the markets. It is not necessarily the case that production in Madagascar will do Zanzibar real harm.

As the production of eugenol from leaves by local distillation has proved capable of successful competition

with clove oil distilled in Europe, the synthetic vanillin problem must be reviewed. It is considered highly probable that clove leaf oil may become a more serious competitor than guaiacol or safrole, and it would seem that it is in Zanzibar's power to solve the problem very much to her own advantage. Organisation of production and marketing, together with local distillation, will, in Mr. Kirkham's opinion, meet present and future difficulties and not improbably bring about a broader and firmer basis upon which the agricultural and financial prosperity of the country may rest.

**The Preparation and Packing of Oranges for Transport.**—In view of the fact that Australia is likely soon to enter the market as an exporter of oranges, it has been considered desirable to have information available as to the methods used in other countries for preparing oranges for transport. A summary of the procedures adopted in California and South Africa has accordingly been issued as *Pamphlet No. 7 (1928), Council for Scientific and Industrial Research, Commonwealth of Australia*, entitled "The Export of Oranges."

The technique of picking, washing, grading, "sizing," packing, cooling and stacking in railway cars is dealt with, and an account of the "Brogdex" process is given. This consists in the main of two parts, first, immersion of the fruit in a 4 per cent. solution of borax at about 115° F. ("Brogdite" treatment), followed by drying, and secondly subjection to a thin spray of paraffin wax ("Brogdex" treatment). The first part of the process cleans the fruit and improves its appearance; the second is a corrective to the removal of the oil by the earlier treatment, slows down the respiration of the fruit without entirely closing the pores, and protects any cuts in the skin. The process is universal in California and is being adopted in South Africa. It is covered by patent rights owned by an American company, but recently an Australian company has taken over the rights in the Commonwealth.

Reference is also made to the practice of colouring citrus fruit by exposure to ethylene gas. This is standard practice in the United States for oranges that are too green for ordinary packing, and for colouring lemons quickly when the market is good, though it is stated to have a softening effect on the fruit.

Recommendations for adoption in Australia include cutting (not pulling) the fruit from the trees, the use of gloves in handling the fruit, the observance of strict cleanliness in packing houses, and the use of the borax

and paraffin process. In addition, suggestions are put forward for the use of a distinctive marking on individual oranges to indicate quality, and observations are made regarding methods of packing and the desirability of pre-cooling before shipment.

**Sand-drift Planting in Cyprus.**—The important question of controlling and reclaiming sand dunes and other sandy areas is at present receiving much attention in a number of countries. Excellent accounts of the work done in this direction in Palestine, for example, are contained in two articles by F. J. Tear, Deputy Director of the Department of Agriculture and Forests, in *Empire Forestry Journal*, Vol. IV (1925), No. 1, pp. 24-38; and Vol. VI (1927), No. 1, pp. 85-93. The following account of the planting of sand areas in Cyprus has been furnished to the Imperial Institute by Dr. A. H. Unwin, Principal Forestry Officer.

For fully the last twenty-seven years, areas of drifting sand have been successfully planted up in Cyprus, the total area now reaching 1,690 acres. Judging by the reports from other countries, it appears that the conditions in Cyprus are not so difficult as for instance in France. Generally speaking, the areas to be dealt with are small (the largest is now in hand and comprises 1,500 acres), whilst the meteorological conditions also appear to be favourable or not adverse in one respect, which is of a determinative and fundamental nature in most cases. During most of the year, the island is under the influence of a warm to hot south-westerly wind, which carries a good deal of moisture. During a short period in the summer (August-September) the northern part of the island is under the influence of a very dry north-easterly wind. In the winter, in December and January mostly, the whole island, except part of the south-western portion, is influenced by a similar wind. In general, therefore, sand which has been blown a little to the east becomes blown partly back again to the west, so that the dunes do not move so fast as in most countries.

From three analyses of the sand in three plantations, it appears that although in most cases up to 62 per cent. of silica is present, nevertheless in all cases the soil contains sufficient mineral salts to induce a fair growth of trees. As Mr. Hutchins pointed out in 1908, the main consideration is the lack of water either in the form of rainfall or underground sources near the surface. It is almost entirely near the sea coast that sand dune-planting has

been necessary, though there are three other small areas inland, where sandy areas have been or have yet to be planted up.

In most cases there is really a main sea dune extending for 100 yards or more up to nearly four miles from the high-water mark. In several cases, there is a strip of cultivable land between a very narrow sea dune (10 yards) and the sandy area proper. Where the dunes extend more than 100 yards, the more or less regular type of undulating dunes are found right back to the furthestmost edge. However, in one of the largest areas, the results of the dune formation are mitigated, owing to the fact that part of the land covered and to be covered is a hard limestone or sandstone. Moreover, the amount of sand released or loosened each winter by the wave action of the sea is not very large.

Hurdles or other protective measures have not hitherto been found necessary in reafforestation, but in the large area now being taken in hand it appears that either a continuous fence of branches of trees (*Acacia*), or here and there palisades of wood, will have to be erected to stop the sand from covering the smaller seedlings.

In the earlier days, a suitable site was first chosen for a well, and, provided water was found, a tank was built near it. An air motor was then installed, and a nursery large enough to raise sufficient seedlings for the area to be irrigated by the air motor was laid out.

Gradually raised sandbanks were piled up, on which irrigation channels (made of half-round tiles) were laid. The slope was, of course, arranged from the tank outwards and downwards, so as to ensure an even flow of water over the area planted up. The planting was done as soon as the channels were completed.

When the area was more or less completely planted up, the air motor was moved to another site in the same plantation. In one case the existence of a high dune near a good water supply allowed a more than average area to be irrigated from the same well. The planting distance usually adopted was 6 ft. by 6 ft. each way, each plant being exactly opposite to the other and the lines quite straight.

Incidentally, as yet no difficulty has been found in obtaining water within a reasonable depth. Just recently sub-artesian water has been found in two plantations at 47 ft. and 235 ft. respectively, and it is intended to irrigate always in order to augment the annual increment and make possible the growing of the most valuable species.

Until the year 1921 no sowing of the sandy areas had

been attempted. For the first few years sowing single or a few seeds in holes did not give very good results, but this method proved useful for filling blanks in existing plantations which were rather far from water and of too small an area to be dealt with otherwise.

Since the year 1925, a tractor with a plough, harrow and drill have been used with excellent results. In many cases it is only necessary to harrow the ground and then drill the seed in.

An analogous system of wells and air motors has been adopted, except that it is contemplated to continue the watering or irrigating, so as to augment the annual increment of the trees on the area. In the first two seasons the whole of the sown area is watered, or as much as can be done either with carts, or donkeys, or by means of gravitation channels during the summer months.

Although the watering is expensive it appears to be indispensable in the climate of Cyprus, and the seedlings make a much quicker start and cover the ground much sooner. In 1922 when there was insufficient money for watering the mortality of seedlings was very great. The growth of the trees, being absolutely certain with the water and very quick, justifies the expense. In essence it means that the rotation may be shortened and yet the same sized tree, if not bigger, be obtained in a lesser period of time.

By far the largest proportion of the plants used were the wattle, *Acacia cyanophylla*, and to a slight extent *Acacia longifolia*. Everywhere the former species has proved most drought-resisting, and also a quick grower. It also acts as a wonderful nurse for both aleppo and stone pine, *Pinus halepensis* and *P. Pinea* respectively. Cypress, *Cupressus sempervirens*, also benefits, but is rather more liable to be misshapen or to be dominated by the *Acacia* until the latter is cut down. The cypress on the whole grows slower on sand dunes than elsewhere.

Other species employed include *Dodonea viscosa*, a shrub-like tree useful for windbreaks, as well as for hedges, even right on the sea-beach. It is very drought- and fire-resisting. Natural reproduction of *Dodonea* has been found to take place under the densest shade of the *Acacia*, whilst in less shady places it has not come up. The Mexican ash, *Fraxinus velutina*, has been grown, but its very slow growth does not justify a place in most plantations, though the foliage makes a valuable though thin layer of humus.

An interesting tree for sand-dune planting appears to be *Cupressus guadalupensis*, which has grown well and is now bearing seeds at an age of about twenty-five years.



The growth is freer than that of *C. sempervirens*, and its root system seems to be wider spread than in the latter, so that it is not so easily blown over or out of the perpendicular, as occurs sometimes to *C. sempervirens*.

Of the Eucalypts, *Eucalyptus globulus* has grown moderately well near the irrigation channel; *E. tereticornis* and *E. sideroxylon* grow well also, though the latter was watered at first.

*Callitris quadrivalvis* has been tried to a slight extent and will be introduced on a larger scale in the future. *Lycium chinense* (*L. barbarum*) has been tried, but it is most suitable as a hedge plant, as usually under Cyprus conditions some more valuable species of shrub or tree can be grown.

Simply as an experiment the carob, *Ceratonia Siliqua*, was planted as an undergrowth- and soil-protecting tree many years ago. The growth has been very slow and its value in sand-drift areas is therefore problematical.

The olive, *Olea europea*, has been planted to a slight extent, but its growth is somewhat slow. It is really not fast enough to cover the ground early.

Recently the false acacia, *Robinia Pseudacacia* has been tried, but it is too early to say whether the results will be of the best. It grows in several places, but fails quite unexpectedly, presumably owing to deficient rainfall. However, a large number of experiments will be made in order thoroughly to test it.

Other local tree-like shrubs are the juniper, *Juniperus Oxycedrus*, and lentisk, *Pistacia Lentiscus*, the latter of which is very common on sandy areas where water is to be found, especially near the sea. Neither, however, are really large enough to hinder the drifts finally. However, in mixture with other species they may prove invaluable.

In the Salamis area, where planting was originally started forty-eight years ago with stone pine, *Pinus Pinea*, the trees have attained a girth of over 6 ft. and a height up to about 40 ft. Already there is a little natural reproduction of the stone pine at Salamis. Slaty gum, *Eucalyptus tereticornis*, which is much younger, has grown taller but with a lesser girth.

The wattle, *Acacia cyanophylla*, has thrived excellently, being cut over after every six years in order to yield firewood. It sprouts well from the stump, and even where an old stump dies shoots appear in abundance from the roots to take the place of the old tree. The growth appears to be about 20 cubic ft. per acre per annum on the average.

The Aleppo pine, *Pinus halepensis*, yields poles after twenty-five years. The intention in all cases is to convert

the coppice plantations of wattle into high forest of pine and eucalyptus, leaving the acacia as an undergrowth.

In the older plantations the cost has varied from £2 7s. 3cp. to £6 17s. per acre, excluding the cost of air motors, digging wells and fences.

The present cost of planting is £1 9s. per acre on the average, which excludes the cost of fencing and watering. Fencing costs £3 6s. per acre and watering £4 per acre by means of a cart.

On the whole the cultivating and sowing with a tractor has proved most satisfactory, especially where water can afterwards be conveyed to the area, either by a water channel or by means of a cart or donkey with water panniers. In this case the total average cost per acre amounts to £1 5s.  $\frac{1}{2}$ cp., the separate items being ploughing 12s. 4cp., harrowing 3s. 6cp., sowing seed with tractor 3s., and watering 5s. 8 $\frac{1}{2}$ cp.

## RECENT RESEARCH ON EMPIRE PRODUCTS

### A Record of Work conducted by Government Technical Departments Overseas

SINCE the publication of the last number of this BULLETIN, reports on research work carried out during the last half of 1927 have been received from the Agricultural Departments in Gambia and Mauritius, and are printed in the following pages. A summary of the work conducted at the Imperial College of Tropical Agriculture, Trinidad, has been received from the Principal, and the Director of Agriculture, Ceylon, has kindly furnished an advance proof of his Report for 1927; abstracts from these are also included.

## AGRICULTURE

### SOILS

**Mauritius.**—Dr. H. Tempany, Director of Agriculture, has furnished the following report on the work relating to soil problems undertaken by the Chemical Division during the last half of 1927.

With a view to determining the availability of phosphates in the soil, different phosphatic manures—super-

phosphate, precipitated phosphate and basic slag—were applied to 2 kilogram samples of a slightly acid soil, in varying proportions, and also with and without simultaneous applications of lime as indicated by the Hutchinson-MacLennan method. It was found that in all cases very considerable reversion had taken place, the least availability as indicated by Dyer's citric soluble method being in those samples where lime was applied to the soil. After the conclusion of these experiments, maize seedlings were grown in the different samples, and it was found that the healthiest and most vigorous growth took place in those samples to which both lime and phosphatic manures had been added. Subsequently, the water-soluble phosphoric oxide was determined by the colorimetric method of Denigès, and in this case it was found that those samples to which lime had been added contained the largest amount of water-soluble phosphoric oxide. The amount of phosphates in the maize seedlings is now being determined.

Work is at present in hand to find out if potassium may be fixed in the soil in a condition not easily available to the plant. The availability is being tested by two methods: (1) Dyer's citric soluble method and (2) Hissink's method, where the potash replaceable by ammonium chloride is determined. Different manures containing potash are used, e.g. potassium nitrate, potassium sulphate, and molasses. The final determinations are in hand.

The physical characters of various soils have been examined by the Keen-Rackowski method, and other work is at present in hand. Extreme variations in the soils so far completed have been noted. Thus, for instance, the apparent specific gravity varies between 1.253 and 0.902, the amount of water taken up by the unit weight of soil from 1.08 to 0.59, and the volume expansion from 32.1 per cent. to 4.25 per cent. These figures show that the physical structure of soils in the Colony must vary to a very large extent. This work will be continued.

The official method for the mechanical analysis of soils, adopted by the Agricultural Education Association in 1925, has been tested out in a preliminary manner against the Osborne beaker method previously used in the Department's laboratory. The results already performed on two

soils would seem to indicate that the official method may well be substituted for the more laborious Osborne method. It would seem that, in spite of the fact that Mauritius soils are highly ferruginous, yet the dispersion by means of hydrogen peroxide and N/5 hydrochloric acid is efficient, and in both cases the percentage of clay obtained by the official method is higher than that by the Osborne method. The following are the results obtained with the two soils.

	SOIL A.		SOIL B.	
	Osborne Method. <i>Per cent.</i>	Official Method. <i>Per cent.</i>	Osborne Method. <i>Per cent.</i>	Official Method. <i>Per cent.</i>
Silt . . .	9.8	7.25	6.4	6.4
Fine Silt . . .	16.9	15.5	27.9	21.9
Clay . . .	41.8	48.9	28.1	29.1

Other analyses are in hand.

**Trinidad.**—Professor F. Hardy, of the Department of Chemistry and Soil Science, Imperial College of Tropical Agriculture, in a summary of the research conducted by his Department during the first half of 1928, states that the following two main lines of soil work are being followed.

(1) *Elaboration and application of methods* for mapping, classifying and examining soils in the laboratory and in the field, in order the better to describe their moisture status, nutrient status, lime status and organic matter status. This work has arisen largely out of a detailed field survey of the sugar-cane soils of Trinidad, which are being studied in their special bearing on the relationship which appears to exist between soil composition and susceptibility to blighting of sugar-canes by the froghopper pest.

The following progress has been made.

A method of expressing soil texture by a single-value constant has been devised (Index of Texture = Moisture Content at Point of Stickiness minus 1/5th of percentage of Sand). This index has proved of considerable service in classifying and plotting on maps some 3,500 soil samples that have been so far obtained during the soil survey in Trinidad. The method has been published in a paper by Professor Hardy, entitled "An Index of Soil Texture" (*Journ. Agric. Sci.*, vol. xvii, No. 2, April 1928).

The application of the quinhydrone electrode to the

rapid determination of  $pH$  values of large numbers of soil samples has been developed and standardised.

A rapid method of determining "lime requirements" of soils by use of the quinhydrone electrode has been devised.

The genesis of the main soil-types of Trinidad has been studied by a preliminary examination of their profiles.

An improvement of the technique for measuring the saturation capacity of soils for calcium has been worked out and applied in the study of the lime status of certain Trinidad soils known to support canes both resistant and non-resistant to frog-hopper blight.

Determination of saturation capacity and of exchangeable calcium contents have led to an improved method of determining lime requirements, and have proved of great service in further characterising soils supporting frog-hopper blight free and blighted sugar-canes, which the soil survey showed to possess widely different reaction ( $pH$ ) values.

(2) *Studies on Lateritic Soils.*—Recognition of the fact that the tropical lateritic soils consist fundamentally of different chemical components from those that characterise temperate soils, led, in 1924, to the initiation of investigations into their peculiar physical and chemical properties.

The following progress has recently been made.

Lateritic soils have been differentiated from temperate soils by their behaviour towards certain dyestuffs, which is specific for hydrous alumina and hydrous ferric oxide, both of which predominate in lateritic soils.

Lateritic soils have been found to exhibit characteristic heats of wetting before and after ignition, again because of the presence in them of hydrous alumina.

Extracts of lateritic soils with various concentrations of hydrochloric acid have been found to yield characteristic silica-alumina ratios, which may be correlated with certain properties of laterites.

#### MANURES

**Ceylon.**—The Director of Agriculture, in his Report for 1927, points out that the importance of increasing the organic matter and the humus content of Ceylon soils is

now generally recognised. Tea estates are increasing their amount of green manure trees and shrubs, rubber estates are extending the use of *Vigna* (*Dolichos Hosei*) and coconut estates are making greater use of *Boga medeloa* (*Tephrosia candida*), whilst paddy growers particularly in the north are growing larger areas of sunn hemp (*Crotalaria juncea*) in their paddy fields. The agricultural treatment of these crops has received consideration during the year. At the Heneratgoda Botanic Gardens complete covers of *Vigna* (*Dolichos Hosei*) and *Centrosema pubescens* in a young clearing planted with *Taraktogenos Kurzii* and *Hydnocarpus Wightiana* have been forked in. The fork was completely buried and the soil left rough. The subsequent growth was satisfactory and there would seem to be no doubt that this treatment is possible on level friable soils in the low country. The results indicate that in coconut plantations where creeping cover crops had been established, such crops could be ploughed in with benefit and sufficient plant material would remain uncovered to re-establish the growth. Considerable discussion has taken place as to the treatment of *Vigna* in old rubber. Whilst it must be generally accepted that the best results are to be secured if the green material can be buried in old rubber, this procedure may not be possible unless the cut leafy material is buried in special pits. Such a measure has been adopted in some estates, but in general the Department does not at present consider the cutting of *Vigna* necessary, but rather favours envelope forking wherever this is possible. There have been some indications of the spread of root diseases under heavy covers in old rubber. This matter is being carefully watched and it may result in it being found necessary in some areas to cut the *Vigna* at regular intervals and to reduce forking to a minimum. In tea, envelope forking with the pushing of the leafy material behind the fork is likely to be found the most satisfactory method of dealing with cover crops and with the lopping of green manure trees and shrubs.

With a view to testing the amount of nitrate added to the soil by the burial of green material from different plants, the Agricultural Chemist and the Manager of the Experi-

ment Station, Peradeniya, carried out an experiment. The results showed that :

(1) Maximum nitrate accumulation took place between six and eight weeks after burying the material.

(2) The amount of nitrate present at any particular time depended on the rainfall in the fortnight previous to sampling, the amount of nitrate varying inversely with the rainfall.

(3) Dadaps and *Gliricidia* leaves gave the highest nitrification percentages for Peradeniya conditions, though this will obviously vary with the ages of the material, etc.

(4) The use of non-leguminous leafy material resulted in as great an accumulation of nitrates as when leguminous crops were used.

## BEVERAGES

### *Coffee*

**Trinidad.**—Professor H. R. Briton-Jones, of the Department of Mycology and Bacteriology, Imperial College of Tropical Agriculture, reports that the Viruela or American leaf disease of Arabian coffee is present to a serious extent in some of the higher localities in Trinidad. A preliminary survey of this disease has shown that there are factors, so far not understood, which markedly influence the degree of incidence. Plants growing in certain areas are not markedly affected by the disease, and to explain the difference in the extent of the disease in definite localities, preliminary observations of the root systems and soil under healthy and diseased bushes suggest the necessity for a closer study both of the types of soil and of the incidence of eelworm (*Heterodera*) on coffee. The disease has recently been found seriously attacking some plants of Robusta coffee in Trinidad.

Badly affected and unaffected Arabian coffee bushes can be found under heavy shade and in the open in certain localities. This observation has led to the conclusion that previous statements in regard to the presence of the disease being closely dependent on humid conditions and that reduction of the disease can be effected by increasing the access of sun and air to the coffee bushes is not in

accordance with facts. The work on this important disease is being continued, and both indirect and direct methods of control are being studied.

### Tea

**Ceylon.**—According to the Report of the Director of Agriculture for 1927, 225,043,992 lb. of black tea and 1,991,864 lb. of green tea of a total value of Rs.213,774,632, were exported from Ceylon during the year as against an export of 215,819,449 lb. of black tea and 1,364,217 lb. of green tea, of a total value of Rs.212,163,883, in 1926. This marked increase of crop was due to the favourable season and to the continued attention given to cultivation and manuring. A feature of all well-managed estates has been in recent years the gradually increasing crops resultant from improvements in cultivation methods and liberal manuring. These larger crops are being secured without any fall in quality, and particular attention continues to be given to the production of fine teas of high quality. Factory improvements continue to be made and engineering firms have had a busy year in remodelling and enlarging existing factories and in erecting new ones. Controlled withering still continues to receive special attention, and the general adoption of this system is assisting in securing an even wither and a general evening-up of quality.

Increased attention continues to be given to the question of soil erosion and particularly to the improvement of the organic matter in tea soils. The use of green manure crops is continuing to extend and several new ones are under experiment. In the highest areas above the mist-zone, particularly around Nuwara Eliya, it has been found necessary to cut out the *Acacia decurrens* on account of its being a host plant of *Cercospora theae* which spreads from it to tea. So far it has not been found possible to secure another leguminous plant to replace it. Further suitable green manures are required for a number of tea-growing areas, and these can only be ascertained as the result of trial and experiment. *Indigofera endecaphylla*, the most suitable cover crop so far found for tea in Ceylon, is being spread gradually on a number of estates. It appears to be giving satisfactory results and its effect in the tea plots



of the Experiment Station, Peradeniya, continues to be watched with interest. The data so far secured indicate that its general use as a cover crop in tea can be recommended. The soil under the *Indigofera* was covered with decaying leafy matter and was in a good state of tilth—being much more friable and in a very superior condition to the soil of the neighbouring clean-weeded plots. Determinations of soil moisture in plots with and without *Indigofera* cover have also been ascertained and the results seem to indicate that when cover crops are grown on soils there is a loss of moisture during the first two years and that afterwards the reverse occurs. There are also distinct indications of an improvement in the organic matter in the soil even after two years. There would appear to be no reason why *Indigofera endecaphylla* should not, if treated correctly from an agricultural point of view, provide a means of building up again many of the badly washed tea soils.

Tea Tortrix caused serious damage during the year in several districts. There are also indications that it is becoming more common in districts in which it occurred but rarely in former years. Its range of spread also appears to have widened. Possible control measures were considered during the year, and it was decided by the Estate Products Committee of the Board of Agriculture to have the Tea Tortrix declared as a pest, with the provision that all egg masses, larvæ and pupæ on tea must be collected and destroyed. This regulation was in force during the last quarter of the year and 71,059,886 egg masses were collected according to reports submitted to the Department of Agriculture. The effect of this egg mass collection is to be reviewed again after two years ; in the meantime the Tea Research Institute is making investigations into the possibilities of biological control of the pest.

Tea termites continue the most serious problem the tea industry has to face at the present time. Entry into bushes occurs in a number of cases through wounds caused by wood rot, and there is little doubt that control measures will have to aim at the reduction of wood rot on die-backs after pruning, and to the destruction, if possible, of the termites after they have infested the bushes. Experiments

with various substances for filling wood rot cavities continue, but so far no really satisfactory substance has been found. The termite investigations have been continued by the Entomological Division of the Department and advantage was taken of the leave of the Assistant Entomologist to allow of his proceeding to America to confer with other specialists dealing with termites attacking living plant tissues.

## CEREALS

### *Rice*

**Ceylon.**—According to the Report of the Director of Agriculture for 1927, the work of the Department in the production and testing of pure-line strains of rice has been continued, and a number of tested paddies of superior yielding values are now available for the use of cultivators in several localities. Improvements in the technique of testing these paddies have been made and care is taken that no paddy is passed into the hands of growers until it has been thoroughly tested, unless it is handed over to large land-holders who are prepared to make experimental tests. There is a gratifying demand for pure-line paddies and steps will have to be taken at an early date to evolve a satisfactory system of seed storage and distribution. A beginning has been made with the multiplication of certain types on growers' lands and this system of private seed farms will have to be developed as tested types become available. In Ceylon, as in other eastern countries, if grown by small-holders, pure-line paddies which should be reserved for seed are often consumed and, in consequence, it is necessary to organise a system of seed farms, preferably in co-operation with land-holders, if distribution of seed is to become general.

Experiments in the weeding of paddy have demonstrated the economic value of weeding and the increased yields which can be secured when weeding is satisfactorily done. Arrangements have been made for agricultural instructors to demonstrate the value of weeding in all paddy-growing districts.

The value of green manures, such as sunn hemp, has

also been demonstrated in the Central division and a special competition organised to encourage the use of green manure crops in paddy cultivation.

## FRUITS

### *Bananas*

**Trinidad.**—Professor E. E. Cheeseman, of the Department of Botany, Imperial College of Tropical Agriculture, reports that up to the present time, much more attention has been devoted by his Department to bananas than to any other single crop. The College has been chosen and supported, first by the Colonial Office and more recently by the Empire Marketing Board, as a centre for researches aimed at the ultimate control of the serious malady known as Panama Disease, which hampers banana culture over wide areas of Central America and the West Indies and is distributed in many other parts of the Tropics.

The main share of the botanical section of the College in this work has been the attempt to breed new types of bananas combining the good commercial qualities of the susceptible Gros Michel variety with a high degree of resistance to the disease.

This work was started in 1922 by Dr. T. G. Mason, and continued from 1923 to 1926 by Dr. S. C. Harland, and from 1926 onwards by Professor Cheeseman. Large numbers of banana plants have been raised from seed, and information on the manner of inheritance in this crop is beginning to accumulate. Cytological work has been found to be very necessary in conjunction with genetic investigations, and is also well in hand. So far as details of the banana researches have been published they may be found in the following papers: "Bananas from Seed; Variety Experiments at the Imperial College of Tropical Agriculture," by J. S. Dash (*Proc. 9th W. Ind. Agric. Confer.*, 1924, p. 53), and "Banana Research at the Imperial College of Tropical Agriculture," by E. E. Cheeseman (*Imper. Agric. Res. Confer.*, 1927, *Agenda: Memo. II*).

The results to date are encouraging, and the work will be expanded still more in the future. It involves collection and comparison of varieties, the making of controlled

crosses between them, and intensive study of the morphology, cytology and physiology of the hybrids. The inter-relationships of the numerous cultivated forms of *Musa* may have to be worked out in some detail before the desired types can be raised.

Thanks to a grant by the Empire Marketing Board, a Low Temperature Research Station is in course of erection in which the effect of varying storage conditions on the ripening processes of different varieties of bananas will be studied, with special reference to those varieties which are known to be resistant to Panama Disease, but for one reason or another fail to ship successfully. The breeding programme will thus be amplified by an exploration of the possibilities of utilising existing resistant varieties, and facilities will also be at hand for complete testing of any promising hybrids produced. For this branch of the work a plant physiologist has been engaged as a whole-time research officer, and will take up his duties shortly.

## SUGAR

### *Cane*

**Ceylon.**—According to the Report of the Director of Agriculture for 1927, sugar-cane experiments have been continued at Bibile Experiment Station, at Jaffna Experiment Station, and at Allai. At the last-named station some difficulties were at first experienced in the preparation of good jaggery. These difficulties were eventually overcome and a high-grade jaggery was secured. The yields were very satisfactory at this station and a special report dealing with the work is under preparation. Samples of canes were regularly analysed by the Agricultural Chemist and some good sucrose contents and purities were experienced when the canes were fully ripe. The growth of the ratoon canes has been fairly satisfactory, especially where drainage has been good. There has been some waterlogging of parts of the station and on these patches growth has been poor. The results secured to date indicate that sugar-cane cultivation could be profitably carried out around Allai if lands are properly drained. Yields of over 30 tons in the first crop and around 20 tons in ratoons may be expected, and

the analyses of the juices are satisfactory when the canes reach maturity.

**Mauritius.**—Dr. H. Tempany, Director of Agriculture, reports that the research work carried out by the Sugar Technological Division during the last half of 1927 on the influence of the different methods of producing plantation white sugars on the amount of sulphur dioxide present in the sugar obtained led to the following conclusions :

1. All direct consumption sugars produced in Mauritius contained less than 70 parts of sulphur dioxide per million, the maximum limit allowed by the new Public Health Regulations in England.

2. Sugars coming from factories in which the evaporator syrup was decanted after the addition of phosphoric acid contained least sulphur dioxide ; the quantity appeared to vary inversely to the quantity of phosphoric acid employed.

3. Sugars of the extra fine type, or grade A, obtained by the decantation of the evaporator syrup without using phosphoric acid, with or without the addition of sodium hydrosulphite to the vacuum pan, contained more sulphur dioxide than those produced with phosphoric acid, though the quantity never exceeded 70 parts per million.

4. It would seem evident that the decantation of the syrup plays an important rôle in the total sulphur dioxide contained in Mauritius sugars, the sulphites precipitated during the evaporation being thus eliminated. Further, the phosphoric acid displaces sulphur dioxide and thus assists in obtaining a sugar containing only a minimum of this substance.

The properties of the Uba Marot sugar-cane have been investigated by the Chemical Division of the Department of Agriculture. This cane arose probably as a bud variation of the Uba sugar-cane. It possesses very great vegetative vigour, its yield in the field reaching 60 to 70 tons per acre. In the factory, however, it gives poor returns, due to its low sucrose content. From this investigation it would seem that it is a late-maturing cane, the sucrose content increasing from 7·3 per cent. in August to 12 per cent. in December.

**Trinidad.**—Professor W. Scott and Dr. R. H. Hurst, of the Department of Sugar Technology, Imperial College of Tropical Agriculture, have furnished the following summary of research work carried out by that Department during the first half of 1928.

### 1. *Cane Syrup.*

The details for the manufacture of a high-grade cane syrup have been fully worked out and successfully applied on a factory scale. The following are the main features : Cane juice is clarified with acid phosphate and lime and evaporated to syrup. The syrup is treated with an invertase preparation until the partial inversion of the sucrose has reached a definite point. The temperature is raised to destroy the enzyme, molasses is then blended in and the mixture treated with " Suchar " (carbon). After filtration the syrup is evaporated in the vacuum pan to a density of 81° Brix.

The syrup so obtained is quite clear, has a light golden-brown colour and shows no signs either of crystallising or fermenting. The production by this process of a refined syrup which still retains the characteristic " cane flavour " is considered to be of very great value to factories which are engaged in the manufacture of edible syrup for export to Canada and Newfoundland.

Analysis of the syrup before and after treatment with " Suchar " shows the removal to a remarkable extent of colouring matters and organic non-sugars, particularly those of a colloidal nature. These results are confirmed by the physical measurements carried out.

### 2. *The Manufacture of White Sugar.*

(a) *From Remelted Raw Sugar.*—Raw sugar was washed in the centrifugals to a purity of 99.0, dissolved in water to form a syrup, treated with " Suchar " and filtered. The filtered syrup was perfectly clear and colourless. Evaporation and crystallisation yielded a brilliant white sugar, the purity of which may be judged from the fact that the " molasses " separated from it was quite colourless.

No precipitate from the filtered syrup was obtained by acid-alcohol, indicating the complete (or sensibly complete)

removal of colloidal matter. The surface-tension rose practically to that of a chemically pure sucrose syrup.

(b) *Direct from Cane Juice*.—The juice was clarified with sulphur dioxide and lime. The syrup obtained was treated with "Suchar" and filtered. The filtered syrup retained a little colour which deepened on concentration. The resulting sugar looked slightly grey when placed beside refined white sugar. The experiment indicated that it is not possible to produce direct from cane juice a white sugar equal to refinery sugar.

The results of analysis of untreated and clarified syrup followed those in the cane syrup experiments, but slightly better results were obtained owing to the absence in this case of molasses.

### 3. *Various Methods of Juice Clarification.*

The methods investigated were.

(A) For the production of raw sugar :

(a) Liming only.

(b) Phosphating and liming.

(B) For "Demerara" crystals :

(a) Sulphiting and liming the juice.

(b) Liming the juice and sulphiting the syrup.

(c) Phosphating and liming the juice and sulphiting the syrup.

Numerous experiments led to the following conclusions : Maximum removal of colloids is obtained by liming to the alkalinity, but over-liming produces dark-coloured decomposition products and excessive quantities of "mud." Liming should be regulated to give a clarified juice of pH 7.3. Where the juice is deficient in phosphate (as is often the case) a cloudy clarified juice is obtained. This can be remedied by adding acid calcium phosphate to the raw juice. For the production of Demerara crystals the use of a bleaching agent is necessary and sulphur dioxide is used. The common practice is to sulphite and lime the juice to an acid reaction, but Professor Scott introduced the system of liming the juice and sulphiting the syrup. The advantages of this system are :

(a) More effective removal of colloidal matter.

(b) Better recovery of sucrose by eliminating loss by inversion.

(c) Avoidance of a very troublesome scale in the evaporators deposited by the sulphur compounds.

(d) The assurance that all the syrup entered the vacuum pan at a definite pH (6.1). In this case again, if the raw juice is deficient in phosphate this may be added to it.

#### 4. *Hot versus Cold Liming.*

Preliminary laboratory experiments showed that hot liming had the following advantages :

(a) Greater removal of proteins, since the juice is heated at its natural acidity (pH 5 to 6), and therefore more nearly at the isoelectric point of albumen.

(b) Much less lime is required to give a clarified juice of a definite pH.

(c) A more accurate control of liming is possible since the drop in pH from limed to settled juice is not so pronounced or so variable as in the case of cold liming.

Experiments in hot liming on a factory scale were not very satisfactory, the clarified juice settling very slowly. It is thought, however, that if the factory subsidisers were fitted with steam coils, whereby the juice could be raised to the boiling point after liming, much better results might be obtained. This subject will be reinvestigated during next year's factory operations.

#### 5. *Centrifugal and Super-centrifugal Clarification of Syrup and Molasses.*

These experiments were carried out in the laboratory with the use of a Hamill centrifuge capable of about 3,000 r.p.m. and a Sharples super-centrifuge capable of about 36,000 r.p.m. Analysis of syrup and molasses showed distinct rises in purity (sucrose per cent. : total solids) after centrifuging, the Sharples centrifuge proving, of course, the more effective. Colloidal materials were removed to varying extents. Viscosity showed an appreciable decrease, a point of great importance in the factory handling of molasses in particular.

The time is probably not far distant when every



"modern" factory will be equipped with centrifugal separators.

Further detailed analyses of centrifugal syrups and molasses are at present proceeding.

## OIL-SEEDS

### Coconuts

**Ceylon.**—According to the Annual Report of the Director of Agriculture for 1927, the exports of coconut products and their values from Ceylon during the year were as follows :

	Quantity.	Value. Rs.
Coconuts, fresh . . . .	18,875,750 nuts.	1,515,087
Copra . . . . .	1,982,154 cwt.	31,844,823
Desiccated . . . . .	872,833 "	20,481,761
Oil . . . . .	673,162 "	16,567,773
Poonac . . . . .	173,155 "	1,241,983
Fibre, bristles . . . .	170,728 "	1,569,904
Fibre, mattress . . . .	356,121 "	1,313,404
Coir yarn . . . . .	130,821 "	2,177,824

These figures show a total fall in the value of exports of Rs.2,072,744. This is accounted for mainly by a fall in crops, particularly in the second part of the year, as the result of short rainfall during the previous twelve months.

Cultivation methods show little change. Constant monthly harrowings have been found to produce ultimately reductions in crop yields, and this system has now given place to less frequent cultivation with the burial of weeds and the loppings of green crops. The essential in coconut cultivation is the maintenance of organic matter. *Boga medeloa* (*Tephrosia candida*) has been used as a green crop and has given satisfactory results. Trials with creeping cover crops have begun and there is little doubt that the use of such plants as *Dolichos Hosei* will eventually become general on the best cultivated estates in those districts in which it will thrive.

Pests and diseases of coconuts during the year call for little comment. The causes of root diseases of coconuts are under investigation by Mr. Park; tapering has been investigated in the field by Mr. de Mel and the indigenous parasites of the coconut caterpillar (*Nephantis serinopa*) are being specially investigated in the North-Western Province.

*Ground-nuts*

**Gambia.**—Mr. A. J. Brooks, Director of Agriculture, has furnished the following summary of investigations on the virus disease of ground-nuts carried out by his Department during the last half of 1927. The investigations were directed mainly towards elucidating the following points :

1. What insect is responsible for transmitting the virus in the Gambia ?
2. Study of its life history with a view to ascertaining the most practical means of attacking and controlling it.
3. What are its food plants other than ground-nuts ?
4. Devising means of controlling it.
5. Where do early cases of infection come from ?
6. What is the general effect on the crop ?
7. Is infection carried in the seed ?
8. What is the most susceptible period of infection ?
9. What effect, if any, has rainfall on the incidence of the disease ?
10. The effect of early and late sowings on the incidence of the disease.
11. Can the degree of infection be controlled by fertilisers ?
12. The possibility of raising disease-resistant strains of ground-nuts as a practical means of control.
  - (a) By seed produced by infected plants.
  - (b) From a variety showing definite resistance to the disease.

**Insect Vectors.**—Among the insects collected with the object of determining the carrier of the virus were two species of Jassidæ belonging to the genus *Cicadulina*. Both of these are reported by Dr. Guy Marshall, Director of the Imperial Bureau of Entomology, as being new to science, and the authorities of the British Museum have kindly undertaken to describe and record them. Only two species of this genus were previously known, and as one of these has been proved to carry " streak disease " in maize, it is thought probable that the new species referred to might be carriers of other virus disease. *Aphis leguminosæ* Theo., the aphid carrier of virus disease of ground-nuts in South Africa, has not been found in the Gambia, although much

time has been devoted to searching for it. Observations are being continued on these leaf-hoppers with a view to gaining knowledge as to their habits and food plants.

*General Effect on the Crop.*—Affected plants seldom spread beyond 6 inches, and few, if any, nuts are produced. Empty shells are increased by 34–55 per cent. and as the ground-nut crop of the Gambia is sold “undecorticated” and the normal nut contains 75 per cent. kernel and 25 per cent. shell, any excess of shell above this is penalised by the trade. Good nuts are reduced by virus infection by 54–64 per cent. Badly infected plants are rendered barren, and where infection is slight the total number of nuts is reduced by 18–24 per cent.

*The Incidence of Disease.*—Early sowing offers advantages over late sowings. If the plants survive the first eight weeks from the date of sowing without infection they remain unaffected. If a period of comparative drought is experienced during the first few weeks after germination the degree of infection is much greater. Rain-fall is therefore an important factor in the control of this disease. The most susceptible period appears to be between the middle of July and the middle of August. The intervals between the date of sowing and the first appearance of the disease vary considerably, but the actual dates of the appearance of disease on farms planted on various dates appear to be within 10 to 12 days. The nature of the spread of infection strongly supports the view that it is insect borne. The investigations have proved fairly conclusively that infection is not carried in the seed or soil, and this is a very important factor as something like 800 tons of ground-nut seed are distributed by the Department annually.

*Method of Control.*—Until further investigations have cleared up certain points which are still obscure, the most practical methods of control are : (i) The immediate destruction of all germinating ground-nuts left in the ground from the previous season's crop. A very high percentage of these plants are frequently found to be infected, and it appears to be chiefly by this means that infection is carried over from one year to another. (ii) Sowing should take place immediately the general rains have commenced.

The first few days of rain are invariably followed by a comparative drought of about two weeks' duration. This is a highly susceptible period and can be avoided by sowing towards the end of this drought so that the germinating seed does not appear above ground until it has passed. (iii) Rogueing of all infected plants throughout the growing period.

*Effects of Fertilisers on Raising the Natural Resistance of the Plant.*—The results now shown by the manurial trials over a period of four years tend to prove that while phosphatic fertilisers raise the natural resistance of plants to disease, their application is without any marked effect in the case of virus disease of ground-nuts. Virus infection occurred in all our manurial plots and varied from 5 per cent. to 75 per cent.

*Isolation of Resistant Strains or Varieties.*—Extensive trials are being conducted both at Cape St. Mary and on the Department's seed farms in the Protectorate with a view to the discovery and the multiplication of disease-resistant varieties. Satisfactory progress has been made and three promising varieties showing definite resistance to virus disease have been obtained. They are the "Basse," selected in 1923 by Mr. Brooks, and "Philippine Pink" and "Philippine White," obtained from "Philippine Red," introduced from the Philippine Islands in 1923. It frequently happens in plant life that varieties showing a marked degree of resistance to disease are otherwise unsuitable as commercial types. In the case of these three varieties it is particularly fortunate that they have proved to be excellent types both in yield and in the quality of the oil produced as shown by the following analyses :

Variety.	Yield of dried nuts per acre	Average weight of 100 kernels	Kernels	Husk	Oil M F Kernels	Free fatty acids.
	lb	grams	Per cent	Per cent	Per cent	Per cent.
Basse . . .	2,832	56.02	78	22	51.8	0.15
Philippine Pink .	2,721	60.62	76	24	50.9	0.15
Philippine White .	1,932	67.52	75	25	52.4	0.65

These varieties are being further tested and multiplied for general distribution.

## FIBRES

*Cotton*

**Ceylon.**—The Director of Agriculture, in his Report for 1927, reports that cotton cultivation in Ceylon, owing to the break in the world's prices, had to be assisted by Government. A subsidy of Rs.5.50 per cwt. was paid by Government on all seed-cotton produced. The crop, which was considerably damaged by the heavy unseasonal rains during the harvesting period, only amounted to 2,000 cwt. of seed-cotton. Arrangements were made by Government to purchase the crop on behalf of the Spinning and Weaving Mills at Colombo, and the establishment of three buying stations and stores was completed in the Hambantota District during the year. Three special rotation stations were established and produced their first crops during the year, whilst work on two others was undertaken and crops sown in them for the first time with the north-east rains. Interest continues to be taken by small growers in the Hambantota District in cotton, but the prospects for the 1927-28 crop are not very encouraging on account of the failure of the north-east monsoon rains. Crops on the experiment and rotation stations, however, were promising and seem to indicate that with proper cultivation at the correct season good crops can be grown year after year on the same land in the dry zone. Certain villagers have been impressed by the crops grown on the Embilipitiya station in the Kolonna korale of the Province of Sabaragamuwa and have taken up lands on a system of permanent occupation and cultivation.

*Sisal Hemp*

**Ceylon.**—According to the Report of the Director of Agriculture for 1927 the exports of sisal hemp from Ceylon in that year amounted to 4,140 cwt. of a value of Rs.120,781, as against 5,236 cwt. of a value of Rs.167,700 during the previous year. This reduction was due to the closing down of the Maha Iluppallama estate. The Government Experiment Station at Anuradhapura produced 220 cwt. of fibre during the year, but it was unable to work for more than half the season on account of water

shortage. These experiments on a small scale on the Experiment Station have been sufficiently satisfactory to warrant further trials being made in villages where dry land cultivation of a more or less permanent character is desirable. Steps have already been made to start sisal cultivation in a village in the North-Central Province and to erect a small mill for the manufacture of the fibre. This mill it is proposed to erect and run for a few years and then to hand it over to the village co-operative society. A similar experiment is to be made in the Hambantota District, but a beginning there will not be possible until 1929.

## RUBBER

### *Hevea*

**Ceylon.**—The Director of Agriculture, in his Report for 1927, states that the exports of rubber during the year amounted to 60,728 tons of a value of Rs.129,757,640, as against 63,621 tons of a value of Rs.184,423,215 during 1926. The export of latex amounted to 250 gallons, of a value of Rs.997. The quality of both crêpe and sheet rubber was well maintained during the year. Rust in sheet is now uncommon and mould is much less common. The use of paranitrophenol as a preventive of mould in sheet continues to extend and this has been experimented with in the treatment of spots in crêpe. Formic acid has been found to be as satisfactory a coagulant as acetic acid and is gradually replacing it on account of its being more economical. Complaints have been received from the manufacturers of certain classes of rubber goods that these articles have a slight greenish tinge when made with the rubber prepared with formic acid. This colour is very slight and is hardly to be detected by the uninitiated, and it is unlikely that this difference in a small class of manufactured goods is likely to influence the market which has accepted formic-acid-prepared rubber without comment. One may, therefore, look forward to greater use of formic acid as a coagulant in the future. The economy in using formic acid has been clearly indicated by Mr. O'Brien, Chemist to the Rubber Research Scheme, who shows that

under Ceylon conditions 1 lb. of 90 per cent. formic acid coagulates 300 lb. of sheet rubber, as against 180 lb. by acetic acid, and 330–360 lb. of crêpe as against 200–220 lb. ; moreover the relative prices of the acids are formic : acetic as 48 : 58.

Secondary leaf-fall caused by *Phytophthora* was much less common during the year and in no district was any outbreak at all serious. On the other hand, the leaf disease caused by *Oidium* was much more common, especially in the drier areas, and is causing some anxiety to a few estates. A secondary form of this disease appeared on older leaves and has been the subject of investigation by Mr. M. Park (see *Tropical Agriculturist*, September 1927, p. 147). It is possible that manuring has had a favourable effect on the incidence of secondary leaf-fall caused by *Phytophthora*, and it is to be hoped that the *Oidium* leaf-fall may likewise be rendered less severe by liberal manuring with nitrogenous fertilisers. The direct control of the *Oidium* disease is not thought to be feasible and indirect methods must therefore be employed. In outbreaks of the secondary attack on older leaves, spraying may be useful, but the expenses and difficulties of spraying rubber under Ceylon conditions are considerable.

Brown bast continues to increase in the drier areas and the percentage of affected trees on a few estates is now high. The treatment of this disease has been carefully studied by Mr. Mitchell, of the Rubber Research Scheme, and a full account of the scraping and isolation method recommended for Ceylon conditions was given at the Agricultural Conference held in Ceylon during the year. This scraping method has been quite successful and bark renewal after treatment has come up to expectations. There is, however, no doubt that brown bast will become more prevalent when full tapping is again resumed, and that crop yields, particularly in the drier areas, will be reduced by it. This fact has already been realised by a few estates in the drier regions at high elevations and steps are being taken to replace rubber in such areas by tea.

*Rhizoctonia bataticola* has been found alone in the roots of rubber and also associated with other fungi reputed to be

responsible for root diseases. Work on these root diseases still continues, and it is hoped that the position will become clear at an early date.

The prevention of soil erosion has received further attention on rubber estates. The spread of *Vigna* (*Dolichos Hosei*) has been considerable during the year, but there are still large areas in which it is not being used. This plant has shown itself to be well suited for growth under the shade of rubber, but it is difficult, in certain areas, to establish. The agricultural treatment of this plant is the subject of experiment and its use is certain to extend as its value and agricultural treatment have been further demonstrated. In some areas where *Vigna* has been found difficult to establish, *Centrosema pubescens* has been tried with success, but as a general rule in Ceylon this plant will not thrive in as dense shade as the former. The terracing of young clearings has been done in a few cases, but this method of preventing the loss of good top-soil is not as general as could be hoped for. Careful records of the cost of contour terracing have been kept of some work done on the Experiment Station, Paradeniya, and show that Rs.84.68 per acre may be taken as an average cost for such work.

Continued interest has been taken in the selection of high-yielding strains of rubber. Yield records have been taken on all the rubber owned by the Department of Agriculture and upon a fair number of estates. Some estates have combined in a programme of investigation and experiments, and are establishing bud-wood nurseries and clones of budded trees from high-yielding mother trees. Definite plans of work have been elaborated during the year and, with the liberation of funds from the Rubber Restriction Fund, definite tests of budded areas from known mother trees of high yield will be possible and the establishment of isolated seed gardens carried out. The industry in Ceylon looks to greater commercial success from seed selection than from the establishment of areas of budded plants. Budding is regarded as a ready vegetative means of isolating trees of high value and thereby establishing seed gardens from which selected seed can be secured. Budded rubber has not, however, been available



up to the present in Ceylon for full tapping. Certain areas will be ready for continuous tapping in 1928 or 1929 and the commercial possibilities of such budded areas can then be put to test. There was a keen demand for rubber seed from trees on the Experiment Station and Gardens of the Department, and the same policy of separate collection from high-yielding trees was adopted as in the previous year. In addition a number of seeds from special trees were selected for sowing in the nurseries of the Department and on the Experiment Station of the Rubber Research Scheme for experimental purposes. Bark examinations were made by Mr. Haigh during the year, of trees growing at Peradeniya and Henaratgoda with a view to selecting a number of high yielders for further experimental work.

## ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY

*In this section a summary is given of the contents of the more important recently published papers and reports relating to tropical agriculture and forestry. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.*

### AGRICULTURE

#### FOODSTUFFS AND FODDERS

**Maize.**—According to *Annual Report, 1926, Department of Agriculture, Kenya*, selection work in the field is being carried out in Kenya with good results, and breeding and selection experiments are being conducted at the Scott Agricultural Laboratories. The original ears obtained and planted in 1925 have yielded a type of Flat White (yet unnamed) possessing both high yielding power and high commercial quality. The yield from the selected seed was 3,360 lb. per acre as compared with 1,920 lb. from good seed of the Flat White type ordinarily grown in the country. Attempts are now being made to fix the type by detasseling the male flowers of weak plants, the marking of good plants and the selection of ears for seed purposes from those marked plants.

The Fourth Maize Conference was held during the year under review, and amongst the recommendations are the

following :—(a) that charges for conditioning maize when consigned to the conditioning plant direct be reduced from 60 cents to 50 cents per bag, but that preference be given to maize rejected in the process of grading ; (b) that the grading of Maize Rules, 1925, be amended to provide for the shipment of maize in bulk and the use of second-hand bags for that purpose ; (c) that a plant-breeder solely for maize be appointed. These recommendations were adopted, and in connection with (b) during the year 69,000 bags of maize arrived for grading in second-hand bags, which were emptied into the holds for shipment, the bags being returned to the consignors.

**Wheat.**—According to the same Kenya report, the area under this crop at July 31, 1926, was 43,763 acres, showing a significant increase as compared with the previous year. Good yields are obtained in individual cases but the average still remains low. It is considered that with continued progress for another year or two a normal crop should be sufficient to satisfy the needs of the Colony and neighbouring territories. Important work is being done in the raising of rust-resistant wheats possessing high yielding properties and good milling qualities. Substantial progress has been made and it is expected that, within a few years, the industry will be placed in a more secure position through the introduction of those qualities essential to successful culture under Kenya conditions.

**Coffee.**—The acreage under coffee in Kenya in 1926 was 69,950 acres as compared with 65,140 in 1925, and the value of the exported crop increased from £723,180 to £747,453. The industry, which is the most extensive in the country, provides 32·5 per cent. of the total value of agricultural exports, and 714 (or 39 per cent.) of the European occupiers are coffee planters. The production of coffee has not increased in proportion to the increase of acreage coming into bearing, which may be accounted for by a number of factors, the chief being shortage of labour. Many thousands of acres of coffee are not being properly pruned, the result being reduction in the average yield. Further large areas have been stumped, and these will not be productive for two years. The introduction of Robusta coffee has received serious consideration. It was found that the conditions in the Highlands were not likely to prove favourable to this variety, and there appeared to be a risk of damaging the quality of the Arabica now firmly established. Trials with Robusta as well as Liberica are to be carried out in the coastal region (*Annual Report, 1926, Department of Agriculture, Kenya*).

In accordance with a request conveyed by a meeting of the Coffee Planters' Union of Kenya and East Africa in March 1927, the Department of Agriculture convened a conference in June 1927. Among the resolutions passed was one advocating the establishment by Government of experimental coffee plots with the object *inter alia* of determining the effect of various fertilisers and the incidence and control of pests and diseases. Another resolution deprecated the introduction of Robusta and Liberica types, urging that the risk to the Arabica industry considerably outweighed the problematical advantages which might accrue from the experiment.

**Lucerne.**—The cultivation of lucerne and the essentials for successful growth are discussed by Andrew Cunningham, B.Sc., in *Scottish Journ. Agric.* (1928, 11, 42). Experiments with reference to the selection of soil, variety and inoculation are recorded. The lucerne crop is one of the most sensitive to acidity, and from the determination of pH values it was found that where this value was much below 6 (7 denotes neutrality, while numbers below 7 indicate increasingly acid reactions and above 7 increasingly alkaline reactions) development was so slow that it was impossible to establish a satisfactory crop. Liming the soil in such instances affords only temporary benefit. With regard to varieties the two most frequently employed in the experiments were Provence and Grimm. The latter, which is extensively grown in the northern districts of the United States and in Canada, is more resistant to frost and appears to reach the flowering stage earlier than the former variety under the conditions prevailing in the east of Scotland. The inoculation experiments, in which the bacteria essential to the development of the nodules and the growth of the plant were introduced to the soil, produced increases in the yield of crop from 20 to 162 per cent., indicating that the organism is absent from many soils, which is one of the reasons for the failure of lucerne in Britain. The organism found in lucerne nodules will only cause the formation of nodules on the roots of plants belonging to the genera *Medicago* and *Melilotus*, and but few species of these genera are cultivated in this country. For inoculation the lucerne organism is grown on agar, on the surface of which it appears as a greyish white slime. The slime is scraped off and thoroughly mixed with fresh skim milk. The lucerne seed is then uniformly moistened with the milk and allowed to dry, being meanwhile protected from sunlight, which is injurious to the bacteria. Inoculated seed should be sown as soon as possible after

g, as the bacteria tend to die if the seed is kept. When the nodule bacteria have been introduced into a suitable soil they spread with considerable rapidity. Other soil may be inoculated by sowing on it several hundredweights per acre of the inoculated soil; this method, however, involves considerable labour and is liable to transfer pests and weed seeds.

#### OILS AND OIL-SEEDS

**Coconuts.**—A supplement to the May 1928 issue of *Tropical Agriculture* is entitled "Wilt Diseases of Coconut Palms in Trinidad (Part I)" by Dr. H. R. Briton-Jones. In this paper two forms of wilt disease are described, namely, yellow leaf or tapering stem wilt, and bronze leaf wilt. The former is a chronic malady, and its etiology has not yet been worked out. In trees affected by this disease, the leaves turn yellow from the tips backwards towards the bases and all leaves, including the central ones, become dwarfed. In extreme cases, rotting of the central bud sets in, followed by the death of the palm. The external symptoms of trees suffering from bronze leaf wilt are very similar to those exhibited by palms affected with red ring disease. The three lowest and oldest leaves at least show yellow and bronze colouring, coupled with yellowing at the tips of the next two or three leaves, the extent of the discolouration increasing with the age of the leaf. Bacterial rot often sets in at the base of the young leaves. The cause of this wilt is primarily due to drought and bad tilth. Water-logging of the soil may have the same effect as drought, but this has not yet been definitely established. Confirmatory evidence that drought is the main immediate cause has been obtained by experiments described in the paper which resulted in the production of the typical symptoms. Control measures are recommended which consist chiefly in the improvement of the soil and satisfactory drainage.

**Gorli Seed.**—In the oil obtained from Gorli seed (*Oncoba echinata* Oliver), the presence of a glyceride of chaulmoogric acid was shown by Goulding and Akers (*Proc. Chem. Soc.*, 1913, **29**, 197; see also this BULLETIN, 1913, **11**, 439). The composition of this oil has been recently further studied by D. Jouatte (*Trav. Lab. Mat. Méd., Paris*, 1927, **18**, pt. 3), who has found the fatty acids to contain about 80 per cent. of chaulmoogric acid and smaller amounts of palmitic and gorlic acids. This last-named acid had not hitherto been described. It is liquid

and strongly dextro-rotatory, and closely resembles chaulmoogric and hydnocarpic acids in constitution. Repeated attempts were made to obtain, by crystallisation of the oil, a pure sample of the triglyceride of chaulmoogric acid, but without success.

**Oil-Palm.**—In a paper entitled "Report on the Oil-Palm Industry in British West Africa," F. M. Dyke, technical officer of the Niger Co., Ltd., and Associated Companies, has published an account of impressions received during a recent visit which he paid to British West Africa with the object of studying the palm oil industry and of obtaining an idea of possible improvements. His attention was concentrated particularly on the palm belts in the Lagos and Calabar regions of Nigeria, but brief visits were made to the Gold Coast and Sierra Leone. In the report the actual conditions observed in the different districts are summarised. In Nigeria the more accessible palmeries are being cropped to the limit of their capacity. The increase in the output registered during the last ten years is due essentially to the opening up by motor roads of areas previously inaccessible. Though further relatively restricted increases by the same means are possible, the main method of increasing the output of oil must be the introduction of improved methods of extraction. In the Gold Coast, on the other hand, general apathy and lack of interest are displayed by the natives, and it is very difficult to persuade the farmers to supply fruit to the factories although a man can earn £6 to £9 per month by cutting fruit for the factory against £2 per month by making oil for himself. The relative merits of creating plantations and of improving natural palm forests are discussed. The cost of both is about the same but the latter has the advantage that it produces fruit immediately, while in the former case seven to ten years must elapse before a plantation becomes productive. The strongest argument in favour of the establishment of plantations is that it is during the first five years of its existence that a palm is most susceptible to cultivation. European-owned plantations are not considered essential. The menace from the competition of plantation-produced palm oil, e.g. Sumatran oil, is stated to come not so much from the quantity which can be produced as from the greatly improved quality and the methods of handling and marketing high grades of oil. It is therefore imperative that steps should be immediately taken to extend the use of modern methods in the preparation of palm oil in British West Africa. As regards the size of plant, the experience

of the Niger Co. has shown that a mill with a capacity of 1 ton of fruit per hour is the most suitable. Such a mill, if situated in a dense natural palmery, can obtain all the necessary fruit within a radius of two miles. The plant is so simple that it is expected that African foremen could be trained to run the mill, and it is so designed that it can be easily transported to the intended site either by motor lorry or by canoe. The shipment of palm oil in bulk is advocated, as by this means a more uniform product is assured.

According to *Dept. Agric. Gold Coast, Bull. No. 7, Year Book, 1926* (p. 12) the decline in the oil-palm industry in that country can be ascribed to the following three causes, namely, the competition of other forms of employment; the difficulties in connection with the collection of palm fruits; and the laborious and wasteful methods of preparing the oil by the hand process. In the collection of the fruit considerable time is wasted in searching in the bush for trees bearing fruit, only a small percentage of the palms being fruit-bearers. Further, the yield from the different trees varies greatly and also from the same tree from season to season. It is suggested that these difficulties could be overcome to a great extent if the palmeries were cultivated, as by this means the yield per tree would be increased and the freedom from undergrowth would facilitate collection. In support of this contention the results of the experimental cultivation of a plot of palms at the Government Oil-Palm Plantation at Anaji are adduced. Three plots of natural bush bearing palms were selected. One (plot A), 50 acres in area, was cleared of all growth except palms and was semi-cultivated; the other two plots (B and D), of 20 acres each, were used as controls. The yields from these three plots were recorded from July 1924 to the end of 1926. The semi-cultivated plot A showed an increase in fruit per acre from approximately 1,400 lb. in 1925 to 1,900 lb. in 1926, while the control plots B and D showed a marked decrease from 900 lb. and 775 lb. respectively per acre in 1925 to 245 lb. and 165 lb. per acre respectively in 1926. The uncultivated plots at the beginning of the test gave yields of fruit of the same order as those of the cultivated plot, but whereas the latter maintained and slightly improved its output, the yields on the control plots diminished and became practically negligible. At the end of 1926 the cultivated plot gave a yield of more than seven times that of the control plots. Dyke discusses these results and suggests that another factor besides the effect of cultivation is playing a

preponderating part, viz. the accessibility or non-accessibility due to the absence or presence of dense undergrowth. He remarks that it is difficult to believe that cropping the trees in 1925 can have caused such a marked decrease in yield in the following year when a marked increase is registered for the cleared area.

H. B. Waters, B.A., in the *Sixth Annual Bulletin, Agric. Dept., Nigeria*, 1927 (p. 78), gives an account of his visit to the oil-palm plantations of Sumatra and Malaya in 1926 which was made with the object of obtaining information to assist the Nigerian Government in formulating a policy for the oil-palm plantation industry. A description of the industry in Sumatra is given and the special features are detailed as being: the excellence of the "Deli" type of oil-palm; the improvement by selection; the rapid improvement in cultivation methods; the widespread use of green dressings; the progress in machinery development; the efficiency of the latest factories; the high quality of the oil; and the bulk transport of the oil. He states that the Sumatran oil-palm industry appears to be in a very sound position both agriculturally and commercially. Its only disadvantage compared with Nigeria and other countries of West Africa is the distance from Liverpool, which is twice that from Lagos to Liverpool. The Sumatran industry's greatest safeguard lies in the fact that the main product is a very high-grade oil. The most modern factories turn out an oil with a maximum free acidity of less than 3 per cent. and they will be in a position to guarantee an oil of this high quality. The real danger to the Nigerian industry is not that the cultivation will disappear, for the use of palm oil is firmly established in Nigeria, but that the price of the low-grade oil will be so reduced that it will not pay the Nigerian extractor to produce it for export. The provision of central factories, which was recommended by the Director of Agriculture in 1922, would alter the whole situation, but the cost of capitalising an efficient system of factories in Nigeria would be too high for the Government to undertake and therefore private capital must be enlisted. With regard to the size of the factory, a capacity of four tons of fruit per hour is considered to be the smallest for economic working in Sumatra, but in Nigeria there are other factors that have to be taken into consideration, more especially the transport of the fruits to the factory from the scattered areas, and therefore a smaller size of factory might possibly be a more economic unit. It is not considered advisable that in Nigeria a central factory should

depend for its supplies of fruit on plantations alone but that these supplies should be supplemented by fruit from small holdings. A result of having modern plantations close to small holdings will be that the natives will soon adopt the improved methods of cultivation used on the plantations. Thereby the yield per acre of the fruit would be increased and this, together with the better grade of oil which the factories would produce, would enable Nigeria to compete successfully with Sumatra.

In the *Proceedings of the First West African Agricultural Conference*, held at Ibadan, Nigeria, in March 1927, several papers are published dealing with the oil-palm industry on the West Coast of Africa, in Sumatra and in Malaya. The first of these is concerned with the industry and its problems in Sierra Leone. In this paper the following reasons are given to explain why this country exports a very small proportion of palm oil to kernels in comparison with Nigeria. (a) The percentage of oil in the Nigerian fruit is apparently much higher than in the common type of fruit in Sierra Leone and the percentage of kernels is believed to be correspondingly lower in the Nigerian type of fruit. (b) In the part of Sierra Leone which is non-palm bearing there is no other oleaginous product of any importance, therefore much of the palm oil produced in one part of the country is consumed in the other. In Nigeria the ground-nut industry and the cattle industry form other sources of supply of oleaginous food material. Two different lines of development are suggested in order to enable Sierra Leone to meet successfully the Eastern competition, namely (1) the development of oil-palm growing on modern plantation lines and the employment of up-to-date extraction plant to produce an oil of high quality, and (2) the development of markets within the Empire and in other countries which are more accessible from the West Coast of Africa than from the East Indies. As regards (1) one of the most vital problems to decide is the type of oil-palm to be grown in the plantations. In this connection two alternatives are mentioned, viz. to select the most promising of the West African varieties and to breed up from it, or to import and grow the Deli variety which has proved so successful in Sumatra. The opinion is expressed that the Deli variety should be imported but that selection and breeding should be carried on in Sierra Leone at the same time with the thin-shelled variety imported from Nigeria, and that as soon as the superiority of one has been amply demonstrated, work should be curtailed on the other and attention concentrated



on the more promising type. Demonstration plots of improved wild stands have been established. In these the undergrowth has been cut, the trees cleaned from fungoid and parasitic growths and the stands thinned down to about 60 palms per acre. No records are yet available from these plots. In addition to fostering the cultivation of the oil-palm and improving the quality of the palm oil and kernels, it is considered that the West African Governments should study the question of marketing these products and of discovering new markets. Tentative enquiries have already been made as to the possibility of the direct importation into Canada of kernels from the West Coast. The great difficulty to be overcome in connection with the creation of a palm kernel crushing industry in Canada and elsewhere is the finding of a remunerative market for the kernel cake or meal. Because of the difficulty of disposing of the cake, it is considered more economical at present to purchase the kernel oil in Europe. Therefore any efforts to induce Canada to import and crush palm kernels must be accompanied with suitable propaganda to advertise the value of the cake and to popularise its use. South Africa is named as another market to be explored as there should be a big sale in that country for edible palm oil among the coloured population.

A second paper describes the oil-palm industry in Sumatra and Malaya. In these countries the areas planted are given as being, in 1925, 60,350 and 9,694 acres respectively. In 1926 the normal annual increase of 25 per cent. probably took place, while in addition three companies have taken up new land-concessions amounting to 270,000 acres with a view to future plantings if the industry proves to be a commercial success. In connection with the cultivation it is stated that the earlier practice of cutting away all leaves up to the bunches of fruit is now condemned. Dead or damaged leaves are removed, but the leaves immediately below the fruits are not removed until after the bunches have been reaped. Artificial pollination has been proved to give greatly increased yields, but the resultant heavy crops are too great a burden on young palms. This practice has therefore been discontinued on most estates. Palms begin to bear at  $2\frac{1}{2}$  to 3 years of age and in the tenth year yield over 1,000 lb. of palm oil per acre. Several new factories have been erected in Sumatra in the last three years and equipped with plant manufactured by Messrs. Krupp and Co. of Germany. In general, the factory processes include steam sterilisation of the whole bunches, double pressing of the fruits in hydraulic presses and extraction of the residual oil in the pericarp

waste with benzene. It is claimed that from 99.5 to 99.7 per cent. of the available oil is recovered in these factories. The use of the centrifugal method of separating the oil has been discontinued in Sumatra as by this means only 24 per cent. of oil is obtained from the fruits against 29 to 30 per cent. by the use of hydraulic presses. Broken shells are separated from the kernels by means of an elutriator working in clean water, and the use of the clay-suspension method will thereby be gradually displaced. The cost of casks for packing the oil is a very expensive item and for one estate in Malaya is quoted as being equal to the plantation and factory costs, viz. £6 per ton. To reduce this charge the oil in Sumatra is being railed to the Coast in 7-ton cylindrical wagons and there discharged into large tanks to await shipment. According to Waters (*loc. cit.*), plans have been worked out for the shipment of the oil in bulk by tank-steamers, and the transport of oil is now being effected in this way.

In a further paper, entitled "The Extraction of Oil-Palm Products," a review is published of the various methods employed for the preparation of palm oil and the separation of the kernels from the broken shells. This review is prefaced with a description of what occurs when palm fruits are allowed to undergo fermentation with the consequent hydrolysis of the palm oil.

In these *Proceedings* details are also given of the regulations that are in force to improve the quality of the palm oil and kernels exported from Nigeria. According to these regulations palm oil must not contain more than 2 per cent. of water or extraneous matter, and palm kernels must not contain more than 4 per cent. by weight of shell, fibre, rotten or decayed kernels or extraneous matter and must be thoroughly dry and hard. The kernels are to be sieved before being bagged.

Preliminary trials conducted in 1926 in Dabou, Ivory Coast, with light presses have shown that such presses could be used by natives for obtaining palm oil with less than 5 per cent. of free fatty acids and only small amounts of impurities. Further tests have been carried out recently in the Grand-Lahon district. The results have shown that by using presses time is saved, a larger yield of oil of a better quality is obtained, and fresh fruit can be easily treated. The demonstration was considered satisfactory and the natives, once they had overcome their scepticism, displayed considerable interest. There should be no difficulty in the commercial production

of palm oil by the natives of the Ivory Coast by the use of these presses (*L'Agron. Colon.*, 1928, 17, 83).

#### ESSENTIAL OILS

**Peppermint Oil.**—Experiments in the cultivation of peppermint in Australia with a view to commercial development were first made in 1920 on the initiative of Messrs. Plaimar Ltd., Perth, Western Australia, and oil distilled by them during the following three years was found on examination in this country to compare very well with English peppermint oil. Up to the middle of 1927, 175 lb. of oil had been produced, and the price obtained for the oil in 1926 was stated to be £7 per lb. The average yield of oil per acre from a full-bearing crop is said to be 20 lb. In 1927 the Commonwealth Tariff Board received an application from Messrs. Plaimar Ltd. for a bounty of 45s. per lb. on all peppermint oil produced in Australia for a period of five years. Although the oil up to that time had cost more than £7 per lb. to produce, it was anticipated that with 25 acres under cultivation the Company would be able to produce peppermint oil at 15s. per lb., and that at the end of five years the production from 100 acres would represent about 11 per cent. of the Commonwealth's annual requirements, the latter being estimated at 18,000 lb. The Company was of the opinion that with the above bounty other growers would enter the industry which would then become self-supporting, and the importation of peppermint oil would to a large extent become unnecessary. The Board were unable to agree with the applicants as regards the amount of the bounty, but in view of the disabilities peculiar to Western Australia by reason of its geographical situation and other local conditions, they recommended that a bounty at the rate of 15s. per lb. be paid on all peppermint oil of marketable quality produced in Australia for a period of five years (*Peppermint Oil, Application for Bounty, Report and Recommendation of Tariff Board*, 1927).

Experiments in the production of peppermint and other essential oils have been carried out in Southern Ireland (*Economic Proc. Roy. Dublin Soc.*, 1927, 2, 285-301). Three hundred peppermint plants purchased from Mitcham were planted at the farm of University College, Cork, at Bishopstone, near Cork, in a fenced garden where the soil was fairly rich but not manured. The green herb, soon after the flowers appeared, yielded about 0.2 per cent. of oil, containing 66.2 per cent. of total menthol, of which

3.3 per cent. was combined. Judging from reports on its examination by experts, the oil was equal in quality to Mitcham peppermint oil.

**Sandalwood Oil.**—An article on the natural and artificial regeneration of the West Australian Sandalwood *Santalum cygnorum* Miq. (*Fusanus spicatus* R. Br.), by H. R. Gay, has been published in the *Australian Forestry Jour.* (1927, 10, 298 and 322). This small tree of straggling habit attains under favourable conditions a height of 25 ft. with a diameter at the base of 10 in. to 12 in. Owing to the settling of farm lands, sandalwood has been obtained progressively further from the seaboard, and is now carted distances of 100 miles to rail-heads. Conservative measures are therefore now being taken, and an enquiry has been held into the nature and habits of the tree. It has been found that the oil is of better quality when derived from trees grown in arid inland districts where little else grows. Owing, however, to difficulties of artificial regeneration in localities where the rainfall is frequently below 10 inches per annum, conservation measures were directed chiefly to protecting naturally well-stocked areas which average 6 trees to the acre. It has been established that sandalwood is a root parasite, although for the first few months of its growth it can live independently. A large number of possible host plants have been identified, and the names of nearly a hundred are appended. The cost and length of time necessary to establish new plantations of host plants would render such a procedure prohibitive, but plenty of suitably stocked land is available where the larger trees were felled 10 to 15 years ago for the Kalgoorlie mines. Sandalwood seeds are large and round; they are found in great numbers under the trees, but few germinate unless they are planted, and even then the season is often too dry for germination to take place. Experiments made by the author seem to show that seedlings from the larger seeds are more likely to survive than those from the smaller, as they are of stronger growth and are able to reach further for a host plant and also to live for longer periods independently. Once established, the parasitic nature of the tree makes it wonderfully drought-resisting. Shade is required by the young seedlings, and is not at all harmful to the growing tree. Near a permanent water supply, the damage done by grazing stock and by rabbits is such that these areas, generally, have not been selected for sandalwood reserves. Experiments in artificial sowing have proved that the seeds will keep well until sufficient rain falls for germination, and that the seedlings are easy

to rear and are not particular as to soil. Now that protective measures have been taken, a few years should see a good stock of artificially sown new growth supplementing the old. At the same time the experience gained will supply information that may now be lacking, and more definite plans for culture may then be made.

An article by E. Perrot, entitled "Les" Sandals d'Australie et Leurs Essences," appears in *Travaux des Laboratoires de Matière Médicale et de Pharm. Galénique, Paris* (1927, 18, 1). The species specially dealt with are *Fusanus spicatus* R. Br. (= *Santalum spicatum* A.DC. = *S. cygnorum* Miq.), to which the name *Eucarya spicata* (R. Br.) Sprag. and Summ. has been recently given (*Kew Bull.*, 1927, p. 193), and *Santalum lanceolatum* R. Br., which is found in north-west Australia. Detailed botanical descriptions are given of these two species, with many illustrations, and particulars are furnished of the characters of the oils derived from them. Both oils contain the same amount of alcohols, expressed as santalol, namely, from about 90 to 96 per cent., and their other constants are identical, with the exception of the optical rotation which ranges from  $-3^{\circ}$  to  $-9^{\circ}$  for *E. spicata* oil, and from  $-30^{\circ}$  to  $-40^{\circ}$  for the oil of *S. lanceolatum*. Australian sandalwood oil is derived principally from the former species, but some commercial oils are mixtures of both these oils, and thus it is possible to obtain Australian sandalwood oil having an optical rotation between  $-13^{\circ}$  and  $-21^{\circ}$ , corresponding to that of Indian sandalwood oil from *Santalum album*. Mention is made of investigations which have been carried out in which the chemical and pharmacological properties of Australian sandalwood oil are compared with those of the Indian oil.

**United States of America.**—The methods of extracting volatile oils from plant material and the production of such oils in the United States form the subject of *Tech. Bull. No. 16* (1928), U.S. Dept. Agric. This pamphlet contains full particulars of experimental methods of extracting oils by volatile solvents, by fats, by expression, and by steam distillation. It also provides illustrated descriptions of commercial processes, including details of design and construction of stills and extraction apparatus. The oils produced in the United States are briefly dealt with. Those obtained from wild plants include sassafras (*Sassafras officinale*), winter green (*Gaultheria procumbens*), sweet birch (*Betula lenta*), witch-hazel (*Hamamelis virginiana*), Canada flea-bane (*Erigeron canadensis*), and pennyroyal

(*Hedeoma pulegioides*), and those derived from cultivated plants comprise peppermint (*Mentha piperita*), the normal yearly production of which is 350,000 to 400,000 lb., spearmint (*Mentha viridis*) produced chiefly in Michigan, where about 40,000 lb. are obtained annually, *Mentha arvensis* var. *piperascens*, American worm seed (*Chenopodium anthelminticum*), of which 60,000 lb. are produced yearly in the Maryland district, tansy (*Tanacetum vulgare*) and dill (*Anethum graveolens*). Other oils mentioned, which are obtained as by-products of other industries, are those of lemon and orange, apricot and bitter almond, cedar-wood (*Juniperus virginiana*) and hop (*Humulus Lupulus*).

## FIBRES

### Cotton

**Ratoon Cotton.**—A valuable publication on the much debated question of the cultivation of cotton as a ratoon crop has recently been published as *Bulletin No. 75* (1928), *Technical and Scientific Service, Ministry of Agriculture, Egypt*. The work has been written by James Templeton, D.Sc., Senior Botanist, Ministry of Agriculture, and is entitled "The Perennial Cultivation of Cotton with Special Reference to the Cultivation of Ratoons in Egypt."

It is pointed out that most authorities are opposed to perennial cultivation on the grounds that the quality of the fibre is said to deteriorate after the first year, and that the plants, if left in the ground for more than one year, will carry insect pests over the winter and thus lead to an increased attack. On the other hand, there are those who maintain that the quality of the fibre does not deteriorate, at least in the second year, and that the damage caused by insects is no greater, and in some cases even less, than in the first year.

An account is given of the evidence relating to the perennial cultivation of cotton in various parts of the world, and the results of experimental work carried out in Egypt are described.

The evidence from most countries where perennial cultivation is carried on appears to show that the yield of cotton is greater in the second year than in the first, though this might also depend on the rainfall. Incidentally it indicates that, even if insect pests are increased, production by the plant more than compensates for the extra damage done. As regards insect pests, it would appear *prima facie* probable that if left in the ground for more than one year the plants would harbour these during the winter with a

consequent increased attack in the following season. Apparently, however, it has never been proved that this actually happens and the experience of many cultivators in several countries is opposed to it. In some cases particular varieties under perennial cultivation are said to be more or less immune to insect pests, while in others this is held to be true for all. In general, however, the subject is one on which very little is really known and is worthy of investigation in all countries where cotton is grown.

It is not possible in a brief abstract to give any adequate account of the experimental investigation described in this work, but the following notes from the author's summary and conclusions may be quoted.

Experiments on the relative behaviour of ratoon and first-year cotton plants were carried out in several widely separated districts in Egypt—mainly Lower Egypt—between the years 1922 and 1926. Special attention was paid to the questions of flowering, yield and quality of the cotton produced, and the damage from insect pests.

The crop from ratoons "arrives" much earlier—up to six weeks—than that from first-year plants. On this account it may command a premium over the later "annual" crop. In almost all the districts the ratoons gave higher yields than first-year plants. Results obtained in the north of the Delta, particularly with Sakellaridis, are of great interest and significance, for the yields secured in the experiments are markedly in favour of the ratoons, which on the estate of His Excellency the Minister of Agriculture gave a yield of at least twice that ever obtained from first-year plants in the district, and actually four times that from the latter in the experiment. As, in addition, the market valuation of the ratoon cotton from the experiments was higher than that of the first-year cotton, everything points to the cultivation of the ratoons along the northern fringe of the Delta, where conditions are very uniform, as being much more profitable to the cultivators than that of first-year plants.

The evidence of the experiments as regards staple quality of first pickings is on the whole definitely against the theory that deterioration takes place after the first year. In addition, the ratoon is usually of a higher "class" than the first-year cotton and consequently the market value of the ratoon is generally higher than that of first-year cotton. Second pickings from ratoons are almost invariably superior in quality in almost every respect to those from first-year plants.

Ratooned plants in Egypt cannot carry the insect pests

of cotton over the winter. They suffer less damage from insect pests in general than first-year plants. Attack by pink boll-worm takes place earlier but is less severe in the case of ratoons than is normally the case with first-year plants, though the latter, if in close proximity to the former, suffer more than they would normally do in the absence of the ratoons.

Other important advantages of growing ratoons compared to first-year plants are that they cost less to cultivate—no seed is required in the second year and no sowing nor resowing nor thinning. The difference in favour of the ratoon cultivation averages about L.E.2 per feddan. Given pure seed to start with it will remain pure longer. For example it need only be renewed every second year if a system of one ratoon were adopted.

At the present time efforts are being made to promote cotton cultivation in new areas throughout the world, but only annual cultivation seems to be countenanced. In all new areas, especially those in which the yields are found to be low, it is recommended that ratooning should be tried, for there appear to be possibilities that areas which are not satisfactory under annual cultivation might be found to be satisfactory under perennial.

In this connection where cotton is grown under irrigation special attention must be paid to the watering of the ratoons, for the system usually applied to "annual" cotton will not be suitable for the former.

The only result of the present investigation which can legitimately be held to apply to all cotton-growing countries is the earliness of the ratoons, and this for the obvious reason that the plants start off in the second year with an established root-system.

### *Sisal Hemp*

**Ceylon.**—An account of the introduction of Sisal into Ceylon and of the experimental work which has been conducted in the Island has been recently drawn up by G. Harbord, Divisional Agricultural Officer, and published as *Bulletin No. 81* (July 1927), *Dept. Agric., Ceylon*, under the title of "Notes on the Cultivation of Sisal with Special Reference to Ceylon."

In 1890, some Sisal plants were forwarded to Ceylon from the Royal Botanic Gardens, Kew, and when planted out at the Experiment Station, Peradeniya, were stated to have grown luxuriantly. In 1906, the plant was said to be growing fairly well in the Botanic Gardens at Anuradhapura. Four acres were planted in 1909 at the Maha Ilup-



pallama Experiment Station, North-Central Province, with bulbils from Peradeniya, and the plantation developed in a promising manner. In 1918-19, a plantation of 18 acres was established at the Experiment Station, Anuradhapura, and three or four years later a small "gratte" machine of the raspador type was erected.

The Government Experiment Station at Maha Iluppallama and the adjacent jungle land was transferred to a syndicate in 1919, which subsequently became the Ceylon Hemp and Produce Company, Ltd. In the first instance 522 acres were planted with bulbils from the Experiment Station and a further area of 641 acres is now being developed. In 1924, a large steam-driven decorticator of the Robey type was installed, which is capable of an output of  $1\frac{1}{2}$  tons of fibre per day.

The spacing of the plants at the Experiment Station, Anuradhapura, is  $6 \times 8$  ft., giving 908 plants per acre, whilst at Maha Iluppallama it is  $8 \times 8$  ft., or 681 plants per acre. At both Stations attempts were made to remove all suckers which developed during the first two years, but this was found to be impracticable owing to labour difficulties, and in consequence trouble was experienced while harvesting the leaves owing to the vigorous growth of suckers clustered round the plants, and the full development of the plants was probably retarded.

The time required in Ceylon for a plantation to reach the producing stage is between  $3\frac{1}{2}$  and  $4\frac{1}{2}$  years, and the experiments at Maha Iluppallama and Anuradhapura have indicated that 7-8 years is the probable duration of life of the Sisal crop in the North Dry Zone. One or preferably two cuttings may be made between January and September, giving an average of about 40 leaves per plant.

A description, with photograph and plan, is given of the fibre machine at Anuradhapura, and data of costs of cultivation and extraction are tabulated.

Analyses of Sisal refuse, both fresh and decomposed, have been made by the Ceylon Government Agricultural Chemist and the results are recorded.

It is stated that the introduction of Sisal as a crop for the villagers would appear to have good prospects in the Dry Zone. The villagers would grow the crop and take the leaves to a central factory, owned and controlled by the Government (see also p. 350).

**Gold Coast.**—In a report of the Committee on Agricultural Policy and Organisation, published on pages 61-66 of *Papers on the Subject of the Accra Sisal Plantation* (Government Printer, Accra, 1927) an account is given of the

working of the plantation in the year 1926-27. The output of fibre amounted to 459 tons, and the net profit, after allowing for capital expenses, interest and depreciation, was £3,091. The factory worked for 275 days, producing on the average 33.38 cwts. of fibre per day. It is stated that the original experiment is now concluded and has proved that the plantation and factory, under the management of the Department of Agriculture, are sound propositions. It now remains for the Government to decide whether special efforts are to be made to foster the industry among Africans. The experiment has shown (1) that Sisal hemp can be grown profitably on the Accra plains, and (2) that it can be profitably extracted at the factory.

The following alternative plans have been suggested for future policy. (1) The Agricultural Department may continue to run the enterprise as it stands at present until all capital has been repaid to Government. (2) The plantation and factory may be sold outright to a private firm or individual. (3) The Department may increase the cultivation up to the limit of the factory capacity, partly by new Government plantation and partly by farmers' and labourers' allotments.

The first of these alternatives could be adopted without any difficulty and the original capital be repaid in from 12 to 20 years. The second alternative would relieve the Government of further responsibility, but sale at the present time would involve loss of part of the capital; moreover, it is unlikely that a private firm would foster the industry among farmers so efficiently and authoritatively as the Agricultural Department could, and more difficulty would be experienced in obtaining labour. The Committee are of opinion that the third alternative would be the best way of establishing the industry, especially if it were accompanied by a scheme to settle a nucleus of population, available as labourers, in the vicinity of the factory, and suggestions are put forward as to means by which this plan could be carried into effect.

With reference to the introduction of Sisal planting among the native farmers, the following remarks by the Acting Director of Agriculture are quoted on page 51 of the same publication. "I am satisfied that the industry can be a profitable one among farmers. At the same time the population within a five-mile radius of the factory (including Achimota village) is limited to 1,600 persons, and it does not appear that the industry can be a large one in that locality unless farmers from elsewhere be settled on the land. In addition, the crop is not a popular one

among local farmers, and special measures will be necessary to induce them to adopt it. During the whole period of the trials, there has not been a single farmer in the neighbourhood of the plantation who has planted Sisal. It is clear that, with this crop as with others, mere demonstration is of little effect, and that other measures will have to be considered if the Government desires to foster the industry."

In view of this, the Committee on Agricultural Policy and Organisation suggest that an area of 500 acres should be divided into blocks of 5 acres each, and that after being cleared and planted by Government these blocks should be offered to farmers at the cost of clearing and planting (about £8 10s.), this amount to be paid by the farmers when their crops are sold. Suggestions have also been made regarding the starting of a co-operative profit-sharing scheme or a system of bonuses to growers.

**Kenya.**—According to the *Ann. Rep. Dept. Agric., Colony and Protectorate of Kenya* for 1926, the Sisal industry in that country is in a flourishing condition. The total area devoted to the crop was 60,197 acres, or 7,325 acres more than in the previous year, and of this 36,538 acres bore plants which were over three years old and ready for cutting. The exports of fibre in 1926 were 294,568 cwts., as compared with 287,260 cwts. in 1925. It is pointed out that the industry is under the control of energetic business men and planters, and that unceasing efforts are being made to improve methods and systems. The efficiency of labour on Sisal plantations shows a gratifying advance, largely due to sound organisation.

## RESINS

**Lac.**—J. H. Lyall, Deputy Conservator of Forests, Bihar and Orissa, has recently published a booklet entitled *Notes on Lac Cultivation, Bihar and Orissa*, based on his experience in the Kundri Reserve in Palamau Division, in Kechki, Ureya and other forests, and also on some observations he has made in the Ranchi and Sambalpur Districts. The subject is dealt with under the following headings: Lac host trees and their suitability, conditions favouring lac development, difference between dry and wet season crops, pruning, infection (general, methods and previous proposals), emergence and attachment of brood, some possible causes of crop failure, marketing of stick lac, sale of brood lac, figures for the Kundri lac area, Government Brood Lac Farms and their prospects, systems of lac cultivation on *Khair* (*Acacia Catechu*) and *Kusum*

(*Schleichera trijuga*), and the association of ants with the lac insect.

The notes are primarily intended to be of assistance to Divisional Forest Officers, and, as stated in the Introduction by Dorothy Norris, Director of the Lac Research Institute, Namkum, "will be found extremely useful to anyone endeavouring to start work of this nature either in newly-formed plantations or in existing forest areas where the same hosts are to be found."

Particulars of "An Experiment in Lac Propagation in the Badami Range, Dharwar-Bijapur Division, Bombay," have appeared in *The Indian Forester* (1928, 54, 235). This work was undertaken after the observation, in the latter part of 1926, of natural lac on trees of *basri* (*Ficus Tsiela*), *siras* (*Albizzia Lebbek*) and *ber* (*Zizyphus Jujuba*) at Kamatgi, near Badami, and the subsequent discovery of occasional occurrences of lac in the neighbouring forests. The insect furnishing this lac was identified as genuine *Tachardia lacca* Kerr, but there is in the forests another species of Coccidæ, occurring on *Acacia concinna* and *A. Latronum*, which produces an inferior lac of no market value.

Experimental lac cultivation was carried out in two plots of approximately four acres each, one in the Anantpur forest near Badami, and the other in the Kamatgi forest near the rest house. The Anantpur plot, about 1,740 ft. above sea-level, has a shallow, sandy loam soil, with a substratum of limestone, whilst the Kamatgi plot, elevation 1,640 ft., has a stony, ferruginous soil. The climate is dry and warm for the greater part of the year, the annual rainfall being about 18–25 in., with a temperature of 70° to 100° F. with occasional brief periods of 108° F. in the summer.

Fourteen different species were selected as host trees (species of *Acacia*, *Dichrostachys*, *Zizyphus*, *Albizzia*, *Cæsalpinia*, *Tamarindus*, *Eugenia* and *Ficus*), there being about 100 trees in each plot. The live lac on the trees at Kamatgi was used as the source of brood supply, and inoculation of pruned and unpruned trees and shrubs in each plot was carried out almost simultaneously in July. *Siras* and *basri* broods were both used, but the majority of the trees were inoculated with the latter, which alone was available in sufficient quantity.

Complete failure resulted with *ghontber* (*Zizyphus xylopyra*), *jamun* (*Eugenia Jambolana*), *tamarind*, *divi divi* (*Cæsalpinia Coriaria*) and *bellad* (*Acacia leucophlœa*), but none of the trees, except *ghontber*, had been pruned. Lac

growth on *wadiya* (*Dichrostachys cinerea*), *ber* (*Zisypheus Jujuba*), *khair* (*Acacia Catechu*), *tugli* (*Albizia amara*), *babul* (*Acacia arabica*), *hadjali* (*Acacia Latronum*) and *basri* (*Ficus Tsiela*) was encouraging, particularly as regards the first-named.

The trees were considerably infested by ants and predatory caterpillars; the former did no appreciable harm, but damage to the extent of about 30 per cent. of the lac was done by the caterpillars in spite of daily removal of the pests. The caterpillars were of two kinds, viz. *Eublemma amabilis*, and a smaller unidentified species.

The result of the experiment so far is regarded as not discouraging, and should it ultimately succeed it is proposed for future work to select areas where the moisture content of the soil is conserved until late in the summer, and to establish brood lac farms at different centres to meet any contingency.

#### TANNING MATERIALS

**Tanning Barks of Madagascar.**—F. Heim de Balsac, and his collaborators, continuing their work on the tanning materials of the French Colonies (see this BULLETIN, 1926, 24, 703; 1927, 25, 72) have recently contributed a further series of articles to the *Bull. de l'Agence Gén. des Colonies* (1927, 20, 775, 969, 1164, 1431), entitled "Contribution à l'Étude des Écorces Tannifères de Madagascar," in which the following tanning barks are respectively dealt with: Mimosas, "Badamier" (*Terminalia Catappa* L.), "Rotra" (*Eugenia* spp.), and "Filao" (*Casuarina equisetifolia* L.). In each case, in addition to general remarks on the distribution and cultivation of the tree throughout the world and the trade in the bark, results of examination of samples at the Laboratoire des Productions Coloniales are given in detail, including the appearance and composition of the barks, nature of the tannin present and the quality of the leather produced, anatomical and histological features being described by means of diagrams.

Amongst the different French colonies where the authors suggest that it should be possible to grow Mimosa (*Acacia*) trees are Tahiti and New Caledonia, certain parts of Indo-China, Tonkin, Southern Annam, and even the high plains of Fouta-Djalon in tropical West Africa, but it is only in Madagascar and Morocco that systematic exploitation has been undertaken. In Madagascar the *Acacia* wood was first used as fuel for locomotives, and it was not until some time later that the bark was employed as a tanning material. In the desolate regions of Vakinankaratra

*Acacia dealbata* was first introduced, but as the bark contains a smaller amount of tannin than that of *A. decurrens* Willd. var. *mollissima* Lindl. (the kind grown in Natal), other species of *Acacia* have since been introduced. At the present time the greater part of the production in Madagascar consists of the bark of *A. dealbata* and *A. decurrens* var. *normalis*.

The examination of five samples of *A. decurrens* bark (variety not stated) showed the tannin content to vary between 24.3 and 27.84 per cent., with the ratio tans : non-tans between 2.7 and 5.3. The authors state that the leather produced is comparable with that furnished by Natal bark, though the amount of tannin present is considerably less.

*Terminalia Catappa* L., known in Madagascar as "Badamier," is met with most frequently on the east coast of the island, being a beautiful deciduous tree with large leaves, and is much planted as a protection against the coastal winds. It is very easily reproduced, but the wood, which is soft and spongy, is stated to be useless. A sample of bark from small and large branches contained 11.8 per cent. of a pyrogallol-catechol tannin, the ratio tans : non-tans being 2.7. Tanning infusions deposit large amounts of "bloom" in the same way as those of valonia and myrobalans, but unlike myrobalans the infusions contain negligible quantities of sugar. The tannin quickly penetrates the skin, producing a fairly plump, rather harsh, stiff leather, of pale chestnut colour. The material, which appears particularly suited to heavy leathers, could be employed locally, but the preparation of extracts is not advised. The author strongly advocates the introduction into Madagascar of certain species of *Terminalia* which produce fruits having a high tannin content, rather than attempting to develop the cultivation of "Badamier."

The genus *Eugenia*, comprising more than 600 species, many of which contain more or less large amounts of tannin in the leaves and bark, is well represented in Madagascar. Two species have been imported from America, *E. Jambosa*, called in Madagascar "Zaham borizano," frequently met with in the undergrowth of the coastal regions, and *E. Jambolana*, which is of very rapid growth. A large number of endemic species exist, but these have not been properly classified. Two only have been described, *E. Parkeri* Bak., and *E. cyclophylla* Bak. The forest species of the genus are known to the natives of Madagascar under the general term "Rotra." The trees are found in all the forests of Madagascar, but are particularly abundant in the coastal forests and highlands of the eastern part of the island.

They are large trees, often attaining 30 metres in height, and have dense foliage and straight trunks covered with a thick bark.

The sample of bark examined, which was obtained from a tree of an unidentified species of *Eugenia*, contained 12.6 per cent. of a pyrogallol-catechol tannin, the ratio tans : non-tans being 1. Infusions of this bark tanned rapidly, producing a fairly plump, pliant, soft leather, of deep reddish-brown colour. The material would be useless for the preparation of tannin extracts, but might be employed locally as a tanning material.

*Casuarina equisetifolia* Linn., known locally as "Filao," is very abundant in Madagascar, particularly on the coast and in the forests of eastern districts; the tree attains a height of 14-15 metres as a rule, with a trunk 60 cm. in diameter. A sample of the bark examined contained 15.3 per cent. of a catechol tannin, the ratio tans : non-tans being 4.1. The material penetrates the skin quickly, and furnishes a fairly plump, pliant and soft leather, of pale reddish-brown colour. The tannin content is only sufficient for local use of the bark, but strong tannin extracts could be prepared. The authors recommend the propagation of "Filao," not only in Madagascar but also in other French colonies.

The tanning barks of Madagascar are also discussed by H. Chauvel in a thesis entitled "*Les Tanins Végétaux et en particulier les Écorces tannantes de Madagascar.*" This is divided into two main parts, the first giving the history of vegetable tannage from an early date, followed by a list of tanning materials classified under the two heads, physiological tannins (sub-headings barks, wood, roots, leaves, fruits and exudations) and pathological tannins or galls, which are then dealt with individually in some detail, and concluding with an account of the preparation of tanning extracts. The second part of the thesis describes the tanning barks of Madagascar in particular, giving diagrams of sections of the barks, results of chemical analyses (carried out by the author and others), and their value as compared with other tanning barks.

The author considers that Madagascar, in view of its native flora and by the extension of the cultivation of the *Acacias*, should have at command an inexhaustible supply of tanning material. As to mangroves, he advocates the cultivation of *Rhizophora mucronata* and *Bruguiera gym-norrhiza*. The stock of these two materials has been much reduced, but the trees grow rapidly and forests could be reconstituted in a few years. The author agrees with

F. Heim de Balsac that of the Acacias *Acacia decurrens* var. *mollissima* is to be preferred to *Acacia dealbata* and suggests that it might even be advisable to prohibit the planting of the latter in order to prevent the formation of hybrids. The installation of factories for the manufacture of tanning extracts is recommended, and for this purpose "Nato" bark (*Mimusops Commersoni*), a sample of which contained 19.5 per cent. of tannin, would be suitable. The barks "Rotra," "Filao," "Badamier," "Fatra," "Pêcher," and *Heritiera littoralis*, which contain between 10 and 15 per cent. of tannin, could be employed for local tannage, but other barks examined, containing less than 10 per cent. of tannin, would be valueless.

## FORESTRY AND TIMBERS

**A Rhodesian Bamboo.**—In the *South African Journal of Science* (1927, 24, 244-258) J. S. Henkel gives the results of an important study of the occurrence, flowering habits and natural regeneration of *Oxytenanthera abyssinica* (A. Rich.) Munro, a species widely distributed in both tropics but constituting the only member of the tribe Bambusæ indigenous in Southern Rhodesia. Its occurrence in the Colony (at Victoria Falls) was first mentioned by F. A. Rogers, but general notice of the plant resulted from the action of Mr. W. E. Thurlow of Bindura in cultivating and marketing the culms in Salisbury under the name of Bindura bamboo. The identification of the plant by Kew as *Oxytenanthera abyssinica* resulted from the examination of flowering specimens collected in 1924.

The plant is an example of a bamboo which flowers gregariously (and also sporadically) at long intervals, the parent stock dying after seeding. The rhizomes are more or less densely clustered and give rise to a clump of culms of which the largest are usually hollow, though solid culms, or stems with very small cavities, may also be present; these latter forms are produced during years of low rainfall or where the bamboo is growing in dry situations. The clumps may be up to nine feet in diameter and sometimes occur as impenetrable thickets covering many acres. Where moisture conditions are good the culms reach a height of 35 to 40 ft. with diameters up to 2½ to 3 in.; in less favourable localities they may be 10 ft. in height and up to 1 in. thick.

The bamboo is distributed primarily in the north-eastern part of the Colony and flourishes under a variety of conditions though reaching its best development in



damp, fertile, well-drained soil. The author gives a detailed list of localities throughout the Colony in which the plant has been recorded.

The observations made by the author since 1921, and by others, leave no doubt that the species flowers gregariously at comparatively long intervals and that such blooming is preceded by the sporadic flowering of some clumps and followed by a final sporadic flowering. Records of such flowerings are given for specified localities in which the flowering period extended over a period of seven years from the summer of 1918-19 to 1924-25.

Interesting observations are recorded concerning the flowering period of plants grown from transplanted rhizomes. Sets removed from the Residency grounds at Salisbury and planted at a higher elevation flowered five years after the parent stock from which they were taken ; but all rhizomes (whether second or third removes) taken from this first transplanted stock flowered in the same season as the first removed stock.

As mentioned above, the plants die after flowering and seeding. Positive evidence as to the length of the life cycle has not yet been obtained, but the author's enquiries indicate a period of about thirty years. The natural regeneration from seed is abundant, and experience so far indicates that artificial reproduction from both seed and rhizomes offers no difficulty. Within its wild habitat the larger mammals are suggested as being the main agents in distributing the seeds which are spiny and would adhere to the backs of animals passing through seeding thickets. The author points out the economic value of the bamboo, which as a living plant he suggests as useful for wind-breaks, hedges and screens, and, in the form of sticks, for framing, pickets, tobacco stakes and many other purposes, not excluding paper pulp. He considers that the Bindura bamboo should be extensively cultivated in Southern Rhodesia.

**The Woods of Katanga (Congo).**—There have been published recently by the Comité Spécial du Katanga, three parts of a systematic study of the useful timbers of Katanga under the title of "*Études Systématiques de Bois du Katanga*" (1928), by M. G. Delevoy. The work was undertaken with the object of making a detailed examination of the chief woods occurring in the forests of the country as a preliminary to the conservation, improvement and exploitation of the timber resources available. In this work the Committee obtained the co-operation of M. de Wildeman in regard to the botanical aspects of the

subject, while Professor M. H. Dustin and M. D. Rosenthal, of the University of Brussels, have contributed the results of mechanical tests of the woods examined. The first part comprises an account of the technical and physical properties of woods and their mechanical characteristics as exemplified by systematic strength tests. This part serves as an introduction to the general work, the second and third "fascicules" of which contain descriptions of the following twelve species of timber: Kipapa (*Afzelia cuanzenensis* Welw.), Mwafi (*Erythrophloeum guineense* Don), Mukula (*Pterocarpus Delevoyi* De Wild.), Ngalati (*Brachystegia mimosæfolia* Hutch. et B. Davy), Musamba (*Brachystegia Bequaerti* De Wild.), Kabamba Katoka (*Brachystegia* sp.), Mulombwa (*Pterocarpus angolensis* D.C.), all of which belong to the Leguminosæ; Mufutu (*Vitex Cienkowski* Kotsch. et Peyr.), Verbenacæ; Saninga (*Faurea discolor* Welw.), Proteacæ; Mufula (*Chlorophora excelsa* Benth. and Hook.), Urticacæ; Libuyu (*Entandrophragma* sp.), Meliacæ; and Mpopwe (*Fagara Homblei* De Wild.), Rutacæ. A number of these timbers will be familiar as occurring in British West Africa. In each case the description of the timber comprises its botanical and native names, the locality in which the sample described was collected, and the general distribution of the tree species, followed by a description of the wood and tables giving the results of the mechanical tests carried out at the University of Brussels. The physical and working qualities of the wood are then dealt with and a statement made as to its actual or possible practical uses.

**Okoumé (Gaboon Mahogany).**—A useful account of this well-known timber, contributed by several authors, appears in *Revue de Botanique Appliquée et d'Agriculture Coloniale*, Bull. No. 76 (December 1927) and No. 77 (January 1928). The first reference to the timber in Europe appears to have been made by Lanesan in *Les Plantes utiles des Colonies Françaises* at the time of the Antwerp Exhibition in 1885. The tree was originally regarded as a species of *Boswellia* but was later described by Pierre as *Aucoumea Klaineana* Pierre. Its geographical distribution is comparatively restricted, the tree being found only in the Gaboon, in Spanish Guinea and in the western part of lower French Congo, occurring in an area extending 2° north and 4° south of the Equator. The tree is a light-demanding species and flourishes on the outskirts of the dense forest, in clearings and in bushy savannahs, and often forms almost pure stands. In spite of the exploitation for some years past the tree is still abundant and reproduces well.

Three varieties of Okoumé are stated to be recognised by the shippers, viz. *zouga*, a red timber ; *nyangala*, a rose-coloured variety ; and *combo-combo* or *cambogala*, which is pale rose in colour. The best qualities of the wood are characterised by a high colour, close grain and smooth surface. As in the case of many other woods wide variations in density are met with and the closest grained and most highly coloured timber is derived from old trees which have grown slowly. The *zouga* variety of Okoumé (which is much valued for veneer) is met with in dry situations in open parts of the high forest ; the wood derived from the maritime regions is lighter in colour, while that grown in humid localities is open and rough grained. Detailed information regarding the chemical and physical characters of the wood and its working qualities, together with a table showing the results of strength tests, are given in Bulletin No. 76. The uses of the timber and an account of the trade are described in Bulletin No. 77, which also includes a section dealing with West African timbers used more or less successfully as substitutes for Okoumé. These woods belong to two botanical genera, viz. *Canarium* and *Pachylobus*, which, it will be observed, belong to the same natural family as Okoumé (*Burseraceæ*).

**Seasoning of Timber.**—Following upon *Special Report No. 1* of the Forest Products Research Laboratory of the Department of Scientific and Industrial Research dealing with the air-seasoning and conditioning of timber (cf. this BULLETIN 1928, 26, 103), the Department has now issued *Special Report No. 2* (1928) entitled "The Principles of Kiln-Seasoning of Timber, Part I: Types of Commercial Kilns in Use." This Report is a brief introduction to the subject of kiln-seasoning, based on experience in the laboratory and on commercial practice in this country as well as in Canada and the United States, and is intended to serve as a basis for future Reports dealing with the investigation of particular problems relating to kiln-seasoning. The conditions in a timber kiln are briefly dealt with, the factors of humidity control, temperature and air circulation being discussed in relation to their rôles in the treatment of the wood, and the modes of operation of the various types of kiln are considered with the aid of a number of diagrams.

**Defects in Timber due to Insects.**—The United States Department of Agriculture have issued, as *Department Bulletin No. 1490*, 1927, a survey of the different types of damage caused to timber by insects. This damage takes

a number of forms, the principal of which may be grouped under three headings, pinholes, grub holes and powder post. The various forms of damage are classified and described in some detail and accounts are given of the insects causing them and their methods of working. Distinction is made between damage which renders the wood unusable and that which need only cause its reduction to a lower grade ; thus powder-posted wood is not only itself subject to progressive damage but is a menace to other wood, whereas "wormy" chestnut, if sound, can be used and exported without fear of further damage either to itself or to other timber. The methods of distinguishing the different types of defect are dealt with. Those that are inevitable are indicated, and in the case of preventable damage the lessening of loss by proper methods of lumbering are described.

## BIBLIOGRAPHY

*Comprising the more important reports, articles, etc., on plant and animal products, contained in publications received in the Library of the Imperial Institute during the three months May-July 1928.*

*The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.*

### AGRICULTURE

#### *General*

Report and Summary of Proceedings, Imperial Agricultural Research Conference, 1927. Pp. 249, 9½ × 6. (London : H.M. Stationery Office, 1928.) Price 1s.

Results of Experiments with Cereals, Sugar Beet, Swedes, Turnips and Potatoes in Yorkshire. *Bull. No. 154, University of Leeds and the Yorkshire Council for Agricultural Education.* Pp. 20, 8½ × 5½. (Leeds, 1928.)

Twenty-fifth General Report of Department of Agriculture and Technical Instruction for Ireland, 1926-27. Pp. 156, 9½ × 6. (Dublin : Stationery Office.) Price 1s. 9d.

Review of Agricultural Operations in India, 1926-27. By D. Clouston. Pp. 158, 10 × 7. (Calcutta : Government of India Central Publication Branch, 1928.) Price Rs.2 or 3s. 6d.

Agricultural Statistics of India, 1925-26. Vol. I. British India. Pp. 81, 13 × 8½. (Calcutta : Government of India Central Publication Branch, 1928.) Price Re.1, Annas 4, or 2s. 3d.

Royal Commission on Agriculture in India. Vol. XII. Evidence taken in Burma. Pp. 515, 9½ × 6. (London : H.M. Stationery Office, 1928.) Price 5s. 6d.

Royal Commission on Agriculture in India. Vol. XIII. Evidence taken in Bihar and Orissa. Pp. 634, 9½ × 6. (London : H.M. Stationery Office, 1928.) Price 6s. 3d.

**Agricultural Implements suitable for the Use of the Indian Cultivator (cont.).** By A. P. Cliff. *Agric. Journ., India* (1928, 22, 95-103).

**Annual Report of the Department of Commerce and Industry, Baroda State, for the Year ending July 31, 1927.** Pp. 72,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Baroda : State Press, 1927.) Price Re. 0.10.0.

**Annual Report of the Department of Agriculture in the Bombay Presidency for the Year 1926-27.** Pp. 269,  $9\frac{1}{2} \times 6$ . (Bombay : Superintendent of Government Printing and Stationery, 1928.) Price Rs. 2, As. 4, or 4s. 3d.

**Season and Crop Report of the Bombay Presidency for the Year 1926-27.** Pp. 89,  $9\frac{1}{2} \times 6$ . (Bombay : Superintendent of Government Printing and Stationery, 1928.) Price Re. 1, As. 11, or 3s.

**The Crops of the Bombay Presidency: Their Geography and Statistics, Part II.** By G. R. Ambekar. *Bull. 146 of 1927, Dept. Agric. Bombay.* Pp. 147,  $9\frac{1}{2} \times 6$ . (Bombay : Superintendent of Government Printing, 1928.) Price R. 1, As. 11, or 3s.

**Studies in the Cost of Production of Crops in the Deccan, No. 1—Crops in the neighbourhood of Poona.** By P. C. Patil, in collaboration with T. G. Shirname and T. B. Pawar. *Bull. No. 149 of 1927, Dept. Agric., Bombay.* Pp. 70,  $9\frac{1}{2} \times 6$ . (Bombay : Superintendent of Government Printing, 1928.) Price Rs. 1.1.6, or 2s.

**Report of the Department of Agriculture, Punjab, for the year ending June 30, 1927.** Pp. 71,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Lahore : Superintendent, Government Printing, 1928.) Price Re. 1.6.0. (1s. 8d.).

**Annual Report on Agriculture, North Borneo, for 1926.** Pp. 8,  $13 \times 8\frac{1}{2}$ .

**Review of Agriculture in Kenya.** By A. Holm. *Bull. No. 9, Dept. Agric., Kenya.* Pp. 12,  $9\frac{1}{2} \times 6$ . (Nairobi : The East African Standard, Ltd.)

**Native Agriculture in Kenya, Improvement, Etc.** By E. Harrison. *Bull. No. 14, Dept. Agric., Kenya.* Pp. 11,  $9\frac{1}{2} \times 6$ . (Nairobi : The East African Standard, Ltd.)

**Annual Report of the Department of Agriculture, Northern Rhodesia, for the Year 1927.** Pp. 16,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Livingstone : Government Printer, 1928.)

**Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1926-27 (cont.).** By H. C. Arnold. *Rhodesia Agric. Journ.* (1928, 25, 377-397)

**Report of the Minister of Agriculture for the Dominion of Canada for the Year ended March 31, 1927.** Pp. 136,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Ottawa : Government Printer, 1927.) Price 30 cents.

**Annual Report of the Department of Agriculture of the Province of Prince Edward Island for the Year ended December 31, 1926.** Pp. 129,  $9\frac{1}{2} \times 7$ . (Summerside : The Summerside Journal Print, 1927.)

**Report on the Department of Science and Agriculture, British Guiana for the Year 1926.** Pp. 76,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Georgetown, Demerara : Government Printers, 1928.)

**Annual Report of the Department of Agriculture, Jamaica, for the Year ended December 31, 1927.** Pp. 30,  $13 \times 8\frac{1}{2}$ . (Kingston : Government Printing Office, 1928.)

**Report on the Agricultural Department, Montserrat, for the Year 1926-27.** Pp. 23,  $12\frac{1}{2} \times 8$ . (Trinidad : Imperial Commissioner of Agriculture for the West Indies, 1928.) Price 6d.

**Plant-breeding at Canterbury Agricultural College. Work on Cereals, Grasses and Red Clover.** By F. W. Hilgendorf. *New Zealand Journ. Agric.* (1928, 36, 156-171).

**Institut für angewandte Botanik, Hamburg. Jahresberichte für die Zeit vom 1. Juli 1924 bis 31. Dezember 1926.** Zugleich 34 und 35 Bericht über die Tätigkeit der Abteilung für Samenkontrolle und 27

und 28 Bericht über die Tätigkeit der Abteilung für Pflanzenschutz. Pp. 135, 9½ × 6½. (Hamburg, 1928.)

Les Stations Expérimentales en Afrique Occidentale Française. By M. Bret. *Bull. Comité d'Études Historiques et Scientifiques de l'Afr. Occid. Française* (1928, 11, 138-143).

Thirty-fifth Annual Report, Minnesota Agricultural Experiment Station. Pp. 50, 9 × 6. (St. Paul, Minnesota: University of Minnesota, 1928.)

Cover Crops in Tropical Plantations. By H. C. Sampson. *Kew Bull.* (1928, 5, 161-183).

Technique in Field Trials. By H. A. Mullet. *Journ. Agric., Victoria* (1928, 28, 65-71).

Crop-Plant Stimulation with Paper Mulch. By L. H. Flint. *Tech. Bull. No. 75, U.S. Dept. Agric.* Pp. 20, 9 × 6. (Washington, D.C.: Government Printing Office, 1928.) Price 10 cents.

The Relation of Electricity to Missouri Agriculture. By R. R. Parks and J. C. Wooley. *Circ. 165, Missouri Agric. Exper. Sta.* Pp. 11, 9 × 6. (Columbia, Missouri: Agricultural College, 1928.)

The Use of Explosives on the Farm. By P. H. Haviland. *Rhodesia Agric. Journ.* (1928, 25, 435-450).

Die Benutzung von Sprengstoffen in den bodenwirtschaftlichen Betrieben. By A. Gross. *Tropenpflanzer* (1928, 31, 167-172).

Irrigation and the Control of Soil Water. By E. S. West. *Journ. Coun. Sci. Indust. Res., Australia* (1928, 1, 174-180).

Die künstliche Bewässerung. By P. Hirth. *Beiheft I, Tropenpflanzer* (1928, 31, No. 3, pp. 1-156).

The Border Method of Irrigation. By S. Fortier. *Farmers' Bull. No. 1243, U.S. Dept. Agric.* Pp. 35, 9 × 6. (Washington, D.C.: Government Printing Office, 1927.) Price 10 cents.

Second Report of the Select Committee on Irrigation Schemes (on Irrigation Amendment Bill) Union of South Africa. Pp. 327 + xxv, 9½ × 6. (Cape Town: Cape Times Limited, 1928.)

Irrigation Requirements of the Arid and Semi-arid Lands of the Missouri and Arkansas River Basins. By S. Fortier. *Tech. Bull. No. 36, U.S. Dept. Agric.* Pp. 112, 9 × 5½. (Washington: Government Printing Office, 1928.) Price 20 cents.

Weeds of Arable Land. By H. C. Long. *Journ. Ministry Agric.* (1928, 35, 50-59; 147-153; 246-252; 356-363).

The Blackberry Pest. III, Control (*cont.*). By E. F. Northcroft. *New Zealand Journ. Agric.* (1928, 36, 261-275).

Canada Thistle, *Cirsium arvense* Tourn. (Field Thistle or Creeping Thistle). By F. Detmers. *Bull. 414, Ohio Agric. Exp. Sta.* Pp. 45, 9 × 6. (Wooster, Ohio: State Agricultural Experiment Station, 1927.)

Johnson Grass as a Weed. By M. W. Talbot. *Farmers' Bull. No. 1537, U.S. Dept. Agric.* Pp. 9, 9 × 6. (Washington: Government Printing Office, 1928.) Price 5 cents.

### The Soil

Some Soil Problems in Kenya. By V. A. Beckley. *Bull. No. 11, Dept. Agric., Kenya.* Pp. 8, 9½ × 6. (Nairobi: The East African Standard, Ltd.)

An Enquiry into Tasmanian Soil Conditions. By J. A. Prescott. *Journ. Coun. Sci. and Indust. Res., Australia* (1928, 1, 227-232).

Soil Erosion a National Menace. By H. H. Bennett and W. R. Chapline. *Circ. No. 33, U.S. Dept. Agric.* Pp. 36, 9 × 6. (Washington, D.C.: Government Printing Office, 1928.) Price 25 cents.

The Influence of Soil Heterogeneity on the Growth and Yield of Successive Crops. By T. Eden and E. J. Maskell. *Journ. Agric. Sci.* (1928, 18, 163-185).

The Specific Conductivities of Soil Extracts. By C. H. Wright. *Journ. Agric. Sci.* (1928, 18, 186-193).

The Mechanical Analysis of Heavy Ferruginous Soils. By R. C. Groves. *Journ. Agric. Sci.* (1928, 18, 200-205).

A Simple Method for the Determination of the pH Values of Turbid Soil and other Solutions. By C. H. Gadd. *Journ. Agric. Sci.* (1928, 18, 206-208).

An Index of Soil Texture. By F. Hardy. *Journ. Agric. Sci.* (1928, 18, 252-256).

An Investigation of the Method of Page and Williams for the Determination of the Saturation Capacity of Soils. By P. E. Turner. *Journ. Agric. Sci.* (1928, 18, 257-265).

The Ammoniacal Nitrogen of Peats and Humus Soils. Part II. By J. C. B. Ellis and C. G. T. Morison. *Journ. Agric. Sci.* (1928, 18, 346-349).

The Results of Drainage and Leaching Trials at Peradeniya during 1927. By A. W. R. Joachim. *Trop. Agric. Ceylon* (1928, 70, 302-311).

Papers prepared for the International Nitrogen Conference held on Board S.S. *Lützow*, May 1928 : (1) Observations on the Association of Ammonia and Nitrate Nitrogen in the Manuring of Crops. By A. Demolon. Pp. 31. (2) Nitrogen Economics. Retrospect and Prospect. By J. Bueb. Pp. 47. (3) Cultivation of the Soil in Relation to Nitrogenous Fertilisers. By L. Brétignière. Pp. 37. (4) Natural and Economic Principles Governing the Use of Artificial Fertilisers. By H. Warmbold. Pp. 94. (5) Irrigation and the Use of Lime in Relation to Nitrogenous Fertilisers. By J. Galland. Pp. 37. (6) Intensification of Arable Crop Production in Relation to Plant Breeding. By E. Baur. Pp. 36. (7) Fertiliser Problems and Prospects in India. By T. H. T. Carroll. Pp. 36. (8) The Chemistry of Intensively treated Grassland. By H. J. Page. Pp. 46. (9) Some Nitrogen Problems. By F. C. O. Speyer. Pp. 52. (10) Research and Education in Relation to Practical Farming. Pp. 28. (Obtainable from Nitram, Ltd., London, free of charge.)

Cost of Producing Farmyard Manure on the Farm of the Hertfordshire Institute of Agriculture. By J. W. Reid. *Journ. Ministry Agric.* (1928, 35, 244-246).

Artificial Farmyard Manure. By M. Carberg and R. S. Finlow. *Agric. Journ. India* (1928, 23, 80-85).

Artificial Farmyard Manure. By T. Petch. *Tea Quarterly, Ceylon* (1928, 1, 6-9).

Artificial Manure Production on the Farm. By W. A. Albrecht. *Bull.* 258, *Missouri Agric. Exper. Sta.* Pp. 20, 9 x 6. (Columbia, Missouri: Agricultural College, 1927.)

"Adco" Manure. Its Composition in Trinidad. By F. Hardy and G. Rodriguey. *Trop. Agric., W.I.* (1928, 5, 144-146).

Synthetic Organic Manure. Methods of Manufacture. By F. Hardy. *Trop. Agric., W.I.* (1928, 5, 172-173).

The Reinforcement of Organic Manures with Artificial Fertilisers. By C. M. Hutchinson. *Agric. Journ. India* (1928, 23, 115-117).

The Principles of the Liming of Soils. *Farmers' Bull.* No. 921. U.S. Dept. Agric. Pp. 21, 9 x 6. (Washington, D.C.: Government Printing Office, 1928.) Price 5 cents.

Nauru and Ocean Islands Phosphates. The Industry and its Future. By A. F. Ellis. *New Zealand Journ. Agric.* (1928, 33, 28-30).

An Economical Method of Manuring with Sann-Hemp. By N. V. Joshi. *Agric. Journ. India* (1928, 23, 86-94).

*Pests—General*

The Biological Control of Insect Pests. By R. S. MacDougall. *Scottish Journ. Agric.* (1928, 11, 25-33).

The Biological Control of Insect Pests. By L. D. Cleare. *Agric. Journ., Brit. Guiana* (1928, 1, 26-33).

Some Hawaiian Experiments in the Biological Control of Insect Pests. By R. Veitch. *Queensland Agric. Journ.* (1927, 28, 145-148).

Legislative Measures in the Control of Insect Pests and Plant Disease. By T. J. Anderson. *Bull. No. 10, Dept. Agric., Kenya*. Pp. 7, 9½ × 6. (Nairobi: The East African Standard, Ltd.)

Cutworms and Army Worms. By R. Veitch. *Queensland Agric. Journ.* (1928, 29, 203-207).

Some Important Discoveries about Migratory Locusts in other Countries and their Application in the Philippines. By F. Q. Otanes. *Philippine Agric. Rev.* (1927, 20, 477-485).

The Porto Rican Mole Cricket. By W. A. Thomas. *Farmers' Bull. No. 1561, U.S. Dept. Agric.* Pp. 8, 9 × 6. (Washington, D.C.: Government Printing Office, 1928.) Price 5 cents.

*Diseases—General*

Some Factors influencing the Occurrence and Distribution of Plant Diseases in Kenya. By J. McDonald. *Bull. No. 13, Dept. of Agric., Kenya*. Pp. 7, 9½ × 6. (Nairobi: The East African Standard, Ltd.)

A Preliminary Note on *Phytophthora* spp. found in Malaya. By A. Thompson. *Malayan Agric. Journ.* (1928, 16, 40-47).

Mycological Notes (9). *Macrophomia phaseoli* (Maubl.) Ashby, the Pycnidial Stage of *Rhizoctonia bataticola* (Taub.) Butler. By J. C. Haigh. *Trop. Agric., Ceylon* (1928, 70, 77-79).

Further Notes on *Rhizoctonia bataticola*. By W. Small. *Trop. Agric., Ceylon* (1928, 70, 227-231).

Notes on *Sclerotium Rolfsii* Sacc. in Malaya. By A. Thompson. *Malayan Agric. Journ.* (1928, 16, 48-58).

Wound Gum. By T. Petch. *Tea Quarterly, Ceylon* (1928, 1, 28-30).

Les Maladies à Virus d'après les Travaux Récents. By M. A. Beauverie. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 334-339; 404-410).

*Beverages*

Cocoa Diseases Prescribed by the Plants (Injurious Pests) Ordinance. By R. H. Bunting. *Bull. No. 11, Dept. Agric., Gold Coast*. Pp. 37 + 12 coloured plates, 9½ × 6. (Accra: Government Printer, 1927.)

Some Aspects of Coffee Production in Kenya. By A. D. Le Poer Trench. *Bull. No. 15, Dept. Agric., Kenya*. Pp. 8, 9½ × 6. (Nairobi: The East African Standard, Ltd.)

Coffee, Principles of Pruning and Observations on Trials. By A. D. Le Poer Trench. *Bull. No. 17, Dept. Agric., Kenya*. Pp. 38, 9½ × 6. (Nairobi: Government Printer, 1927.)

Le culture du caféier dans le Sud des Indes. By Du Pasquier. *Bull. Econ. Indochine* (1928, 31, 49-60).

La culture du caféier Arabica à Java. By G. Frontou. *Bull. Econ. Indochine* (1928, 31, 61-70).

Os trabalhos da Comissão de Estudo e Debellação da Praga Café-eira desde seu inicio. By A. Niva. *Publicação N. 21, Comissão de Estudo e Debellação da Praga Café-eira*. Pp. 27, 9 × 6½. (São Paulo: Secretaria da Agricultura, 1928.)

Biological Control of Insect Pests with Particular Reference to the Control of the Common Coffee Mealy Bug in Kenya Colony. By T. W. Kirkpatrick. *Bull. No. 12, Dept. Agric., Kenya*. Pp. 11, 9½ × 6. (Nairobi: The East Africa Standard, Ltd.)



Tea in North-East India. By P. H. Carpenter. *Agric. Journ., India* (1928, **23**, 5-15; 156-165 (cont.)).

Tea in Java. By C. R. Harler. *Journ. Indian Tea Assoc.* (1928, **1**, 1-44).

Some Problems for the Tea Research Institute (Ceylon). By T. Petch. *Trop. Agric., Ceylon* (1928, **70**, 271-281).

Tea and Soil Acidity. Water Culture Experiments. By C. H. Gadd. *Tea Quarterly, Ceylon* (1928, **1**, 2-6, 31-35).

The Relationship between Manuring and Callus Formation in Tea. By P. A. Keiller. *Trop. Agric., Ceylon* (1928, **70**, 288-301).

Experience in the Use of Creeping Crops in Tea Cultivation, with Special Reference to *Indigofera endecaphylla*. By T. H. Holland. *Trop. Agric., Ceylon* (1928, **70**, 312-318).

Tea and *Indigofera endecaphylla*. By T. H. Holland. *Trop. Agric., Ceylon* (1928, **60**, 67-76).

Weevils Injurious to Tea. By S. Stuart Light. *Tea Quarterly, Ceylon* (1928, **1**, 45-47).

Vegetable Parasites of the Tea Plant. Blights on the Stem. By A. C. Tunstall. *Journ. Indian Tea Assoc.* (1928, **1**, 45-57).

Mycological Notes (X). A Dieback of Tea Seedlings. By L. S. Bertus. *Trop. Agric., Ceylon* (1928, **60**, 80-84).

Mycological Notes (XI). A Preliminary Note on a Mycorrhizal Fungus of Tea Roots. By M. Park. *Trop. Agric., Ceylon* (1928, **70**, 171-174).

The Parasitism of Tea Root Disease Fungi. By T. Petch. *Tea Quarterly, Ceylon* (1928, **1**, 10-15).

A Nematode Root Disease of Dadaps. By C. H. Gadd. *Tea Quarterly, Ceylon* (1928, **1**, 39-44).

#### Cereals

Some of the Cereals in Kenya Colony with Particular Reference to Wheat and the Breeding of Suitable Varieties thereof. By G. J. L. Burton. *Bull. No. 16, Dept. Agric., Kenya*. Pp. 11, 9½ × 6. (Nairobi: The East African Standard, Ltd.)

Fungi Affecting Gramineous Plants of the Gold Coast. By R. H. Bunting. *Bull. No. 10, Dept. Agric., Gold Coast*. Pp. 51 + 11 plates, 10 × 6. (Accra: Government Printer, 1928.)

Field Trials in the Manuring of Malting Barley. By F. Rayns. *Journ. Roy. Agric. Soc.* (1927, **88**, 131-146).

Top-Dressing Maize against Stalk-borer. By D. Ripley. *Farming in South Africa* (1928, **2**, 613-616).

The European Corn Borer and its Controlling Factors in Europe. By W. R. Thompson and H. L. Parker. *Tech. Bull. No. 59, U.S. Dept. Agric.* (Washington, D.C.: Government Printing Office, 1928.) Price 10 cents.

Correlation of Yield in Oats with Meteorological Observations at the University College Farm, Bangor, for the Period 1903-1926. By R. A. Roberts. *Journ. Agric. Sci.* (1928, **18**, 295-316).

Formaldehyde Treatment for Oat Smuts. By V. P. Tapke. *Misc. Publc. No. 21, U.S. Dept. Agric.* Pp. 4, 8 × 3½. (Washington: Government Printing Office, 1928.)

Grey Speck (Manganese Deficiency) Disease of Oats. By G. Samuel and C. S. Piper. *Journ. Dept. Agric., S. Australia* (1928, **81**, 696-705; 789-799).

Rice in Burma (cont.). By D. Hendry. *Trop. Agric., W.I.* (1928, **5**, 51-53).

The Chemical Composition of Some Ceylon Paddies, Rices and Milling Products. By A. W. R. Joachim and S. Kandiah. *Trop. Agric., Ceylon* (1928, **70**, 195-206).

Rice Outturns of Paddies Husked for the Agricultural Chemist. By L. Lord. *Trop. Agric., Ceylon* (1928, **70**, 207-210).

Paddy Notes (III). (a) The Germination of Rice Seeds in Ceylon. (b) The Effect of Attack by Paddy Moth and Paddy Weevil on the Germination of Rice Seeds. By L. Lord. *Trop. Agric. Ceylon* (1928, **20**, 211-215).

La Culture du Riz en Camargue. By R. Lami. *Riz et Riziculture* (1928, **3**, 25-43).

La Riziculture en Cochinchine (concluded). By Tran Van Huu. *Riz et Riziculture* (1928, **3**, 1-13).

La Production rizière et son Amélioration en Indochine. By A. Denis. *Riz et Riziculture* (1927, **2**, 317-325).

Les Engrais verts dans la Riziculture Tonkinoise. By P. Bræmer. *Riz et Riziculture* (1927, **2**, 335-341); and *Bull. Écon. Indochine* (1928, **31**, 204-208).

La culture du riz au Mexique. By L. Marin. *Riz et Riziculture* (1927, **2**, 326-334).

De l'influence du Phosphate de chaux sur le rendement et la valeur nutritive du Paddy. By F. Annotel. *Rev. Bot. Appl. et d'Agric. Col.* (1928, **8**, 397-403).

La Dessiccation Artificielle du Riz. Le séchoir Pomini. By R. Lami. *Riz et Riziculture* (1928, **3**, 45-56).

Wheat Culture in Queensland. By J. C. Brunnich. *Queensland Agric. Journ.* (1928, **29**, 214-221).

The Maintenance of Soil Fertility in Wheat Districts. By E. S. Clayton. *Agric. Gaz., N.S.W.* (1928, **39**, 341-345).

The Influence of Fertilisers on the Vitamin B Content of Wheat. By C. H. Hunt. *Bull. No. 415, Ohio Agric. Exp. Sta.* Pp. 41, 9 x 6. (Wooster, Ohio: Agricultural Experiment Station, 1927.)

Le Climat du Blé dans le Monde d'après G. Azzi. By R. Musset. *Rev. Bot. App. et d'Agric. Col.* (1928, **8**, 241-249).

The Wheat Root Grub (*Anodontonyx tetricus*). By T. McCarthy. *Agric. Gaz., N.S.W.* (1928, **39**, 306-313).

Varietal Resistance and Susceptibility to Wheat Scab. By I. T. Scott. *Res. Bull. 111, Missouri Agric. Exper. Sta.* Pp. 154, 9 x 6. (Columbia, Missouri: University of Missouri, 1927.)

Copper Carbonate Seed Treatment for Stinking Smut of Wheat. By V. F. Tapke and F. C. Meier. *Misc. Circ. No. 108, U.S. Dept. Agric.* Pp. 4. 8 x 3½. (Washington: Government Printing Office, 1928.)

### Sugar

Sugar in Natal. By Sir F. Watts. *W.I. Comm. Circ.* (1928, **43**, 208-209; 228; 248-249).

Cane Varieties Grown in Queensland. Their Resistance to Disease. By E. J. Ferguson Wood. *Queensland Agric. Journ.* (1928, **29**, 261-270).

The Impermeability of British Guiana Sugar Soils, its Consequences and its Amelioration. By M. Bird. *Agric. Journ., Brit. Guiana* (1928, **1**, 34-37).

Conditions techniques et financières de la production du sucre aux Philippines. By Y. Henry. *Bull. Écon. Indochine* (1928, **31**, 141-197 (cont.)).

The Sugar-cane Moth Borer in the United States. By T. Holloway. *Tech. Bull. No. 41, U.S. Dept. Agric.* Pp. 76, 9 x 5½. (Washington: Government Printing Office, 1928.) Price 25 cents.

Cane Diseases in Queensland in 1927. By E. J. Ferguson Wood. *Queensland Agric. Journ.* (1928, **29**, 182-199).

Report on the Fiji Disease Situation in Queensland. Parts I and II.

By W. Cottrell-Dormer. Part III. By E. J. F. Wood. *Queensland Agric. Journ.* (1927, 28, 125-141).

Red Rot Disease of Sugar-cane. By H. T. Easterby. *Queensland Agric. Journ.* (1927, 28, 115-116).

The Allscott (Salop) Beet Sugar Factory. *Journ. Ministry Agric.* (1928, 35, 240-244).

Some Sugar Beet Costs. By E. G. Strutt and W. Gavin. *Journ. Ministry Agric.* (1928, 35, 320-336).

Machinery for the Harvesting of Sugar Beet. By T. Close. *Journ. Ministry Agric.* (1928, 35, 30-35).

Furnaces for making Gul or Crude Sugar in the Bombay Presidency. By P. C. Patil. *Bull. No. 144 of 1927, Dept. Agric. Bombay.* Pp. 35, 9½ x 6. (Bombay: Superintendent of Government Printing, 1928.) Price As. 7-3 or 9d.

### Root Crops

St. Vincent Arrowroot. A Preliminary Investigation. *W.I. Comm. Circ.* (1928, 43, 128-129).

St. Vincent Arrowroot. By G. Wright. *Trop. Agric., W.I.* (1928, 5, 162-166).

The Edible Canna (*Canna edulis*). By D. E. McLoughlin. *Rhodesia Agric. Journ.* (1928, 25, 664-674).

Edible Canna in the Waimea District of Hawaii. By J. C. Ripper-ton and R. A. Goff. *Bull. No. 57, Hawaii Agric. Exper. Sta.* Pp. 41, 9 x 6. (Washington: Government Printing Office, 1928.)

Descriptive List with Cultural Directions of Gabi (*Colocasia esculenta*) Varieties grown at the Lamao Experiment Station, Bataan. *Philippine Agric. Rev.* (1927, 20, 469-472).

Varietal Description of Ubi (*Dioscorea elata*) at the Lamao Experiment Station, Bataan. By J. M. Ejercito. *Philippine Agric. Rev.* (1927, 20, 473-476).

The Manuring of the Potato Crop. By T. J. Shaw. *Journ. Ministry Agric.* (1928, 35, 36-38).

Spraying versus Dusting to Control the Potato Leafhopper in Commercial Potato Fields of Wisconsin. By J. E. Dudley, Jr., and C. L. Fluke, Jr. *Res. Bull. 82, Wisconsin Agric. Exper. Sta.* Pp. 16, 9 x 6. (Madison, Wisconsin: State University, 1928.)

Truck Crop Investigations. The Potato Tuber Worm. By F. W. Poos and H. S. Peters. *Bull. 61, Virginia Truck Exper. Sta.* Pp. 32, 9 x 6. (Norfolk, Virginia: The Virginia Truck Exper. Sta., 1927.)

Factors of Spread and Repression in Potato Wart. By F. Weiss and P. Brierley. *Tech. Bull. No. 56, U.S. Dept. Agric.* Pp. 14, 9 x 5½. (Washington: Government Printing Office, 1928.) Price 5 cents.

Studies on Tapioca. By V. R. Greenstreet. *Malayan Agric. Journ.* (1928, 16, 59-69).

### Fruits

Report on Fruit Investigation during the Australian and New Zealand Season 1927. *Special Report No. 3, Empire Marketing Board.* Pp. 65, 9½ x 7½. (London: Empire Marketing Board, 1928.)

Palestine as a Fruit Producing Country. By O. Warburg. *Palestine and Near East Econ. Mag.* (1928, 3, 222-224).

Orchard Heating and Smudge Firing. By H. Broadfoot. *Agric. Gar., N.S.W.* (1928, 39, 381-388 (cont.)).

Removal of Spray Residue [from Pears and Apples]. *Farming in South Africa* (1928, 3, 835-837).

Successful Codlin Moth Control in Western Australia. By G. W. Wickens. *Journ. Dept. Agric., W. Australia* (1928, 5, 2nd ser., 52-57).

Dusting versus Spraying as a Control for Codling Moth in the

Stanthorpe District. By H. Jarvis and S. M. Watson. *Queensland Agric. Journ.* (1928, **29**, 340-345).

Control of Apple Scab on Allington Pippin and Newton Wonder by Two Types of Bordeaux Mixture. By W. Goodwin, E. S. Salmon and W. M. Ware. *Journ. Ministry Agric.* (1928, **35**, 226-235).

The Cider Industry and the Farmer. By B. T. P. Barker. *Journ. Roy. Agric. Soc.* (1927, **88**, 65-79).

Apricot Pruning in the Lower Northern District. By J. B. Harris. *Journ. Dept. Agric., S. Australia* (1928, **31**, 958-967).

Bananas and Citrus. Report by Dr. Harland on his tour for the purpose of studying Bananas and Citrus (*cont.*). *Trop. Agric., W.I.* (1928, **5**, 54-56).

The Banana in Queensland. By G. Williams. *Queensland Agric. Journ.* (1928, **29**, 346-367).

Banana Growing in Palestine. By O. Warburg. *Palestine and Near East Econ. Mag.* (1928, **3**, 230-231).

La Banane aux Iles Canaries. By G. Lefèvre. *Bull. Ag. Gén. des Col.* (1928, **21**, 147-167).

Baiting for Banana Weevil Borer Control. By J. L. Froggatt. *Queensland Agric. Journ.* (1928, **29**, 282-283).

Preliminary Report on *Fusarium cubense* causing Panama Disease [of Bananas] in Malaya. By F. S. Ward. *Malayan Agric. Journ.* (1928, **16**, 76-87).

Preparation of Flour from Colony Grown Plantains. By W. Francis. *Agric. Journ., Brit. Guiana* (1928, **1**, 48-50).

Hints on the Export of Citrus Fruits. *Farming in South Africa* (1928, **3**, 825-826).

The Export of Oranges. By W. Ranger and W. J. Young. *Pamphlet No. 7, Coun. for Sci. and Indust. Res., Australia*. Pp. 12, 9½ x 6. (Melbourne: Government Printer, 1928.)

Citrus Maturity Test. Directions for Testing Export Oranges for the Sugar-acid Ratio. By F. J. de Villiers. *Bull. No. 37, Dept. Agric., Un. S. Afr.* Pp. 16, 9½ x 6. (Pretoria: Government Printing and Stationery Office, 1928.) Price 3d.

The Future of the Jaffa Orange Industry. By S. Tolokowsky. *Palestine and Near East Econ. Mag.* (1928, **3**, 225-226).

Prospects of the New Orange Plantations. By R. Leshem. *Palestine and Near East Econ. Mag.* (1928, **3**, 227-229).

Inducing Earlier Ripening of the Jaffa Orange. S. Katzprowsky. *Palestine and Near East Econ. Mag.* (1928, **3**, 234-235).

Parasitic Flowering Plants on Citrus Trees. *Farming in South Africa* (1928, **3**, 843-844).

The Control of American Gooseberry Mildew: Trials with Sulphur in the Bristol Province. By R. M. Nattrass. *Journ. Ministry Agric.* (1928, **35**, 161-167).

Le Fruit du "Tai-chua" du Tonkin (*Garcinia pedunculata* Roxb.). I. Intérêt de son exploitation comme source d'acide citrique. By F. Heim de Balsac, H. Heim de Balsac, A. Parveaud and J. Rolland. *Bull. Ag. Gén. des Col.* (1928, **21**, 318-330).

Production of Table Grapes and Raisins in Palestine. By I. Benari. *Palestine and Near East Econ. Mag.* (1928, **3**, 232-233).

Preparation of Eastern Grapes for Market. By B. E. Shaffer. *Farmers' Bull. No. 1558, U.S. Dept. Agric.* Pp. 18, 9 x 6. (Washington: Government Printing Office, 1928.) Price 5 cents.

Vineyard Tillage. By F. de Castella. *Journ. Agric., Victoria* (1928, **26**, 72-84).

Shot-Hole Borer (*Xylion gibbicollis*) [of Grape Vines]. By L. J. Newman. *Journ. Dept. Agric., W. Australia* (1928, **5** 2nd ser., 132-136).

A Study of Phylloxera Infestation in California as related to Types of Soils. By R. L. Nougaret and M. H. Lapham. *Tech. Bull. No. 20, U.S. Dept. Agric.* Pp. 38, 9 × 5½. (Washington: Government Printing Office, 1928.) Price 10 cents.

The Food of Orchard Birds with Special Reference to the Pear Psylla. By T. T. Odell. *Bull. No. 549, New York State Agric. Exper. Sta.* Pp. 19, 8½ × 5½. (Geneva, N.Y.: Agricultural Exper. Sta., 1927.)

Peach Growing in Missouri. By T. J. Talbert and H. D. Hooker. *Circ. 164, Missouri Agric. Exper. Sta.* Pp. 23, 9 × 6. (Columbia, Missouri: Agricultural College, 1927.)

Paradichlorobenzene Experiments in the South for Peach-borer Control. By O. Snapp. *Tech. Bull. No. 58, U.S. Dept. Agric.* Pp. 40, 9 × 5½. (Washington: Government Printing Office, 1928.) Price 10 cents.

Midsummer Sprays for the Peach Cottony Scale. By S. W. Harman. *Bull. No. 552, New York State Agric. Exp. Sta.* Pp. 22, 8½ × 5½. (Geneva, N.Y.: State Exper. Sta., 1928.)

De Ananas-cultuur in Florida. By J. C. Th. Uphof. *Indische Culturen (Teysmannia)* (1928, 13, 126-129).

Der Anbau von Ananas auf Hawaii. By O. Freimund. *Tropenpflanzer* (1928, 31, 137-141).

Persistence of Characters in the Smooth Cayenne Pineapple. By K. Kerns. *Bull. No. 11, Exper. Sta. Assoc. Hawaiian Pineapple Cannery.* Pp. 15, 10½ × 6½. (University of Hawaii, 1928.)

Legumes as Rotation and Trap Crops for Nematode Control in Pineapple Fields. By G. H. Godfrey. *Bull. No. 10, Exp. Sta. Assoc. Hawaiian Pineapple Cannery.* Pp. 21, 10½ × 6½. (University of Hawaii, 1928.)

#### Spices

Iets over Pepercultuur. By S. Kalf. *Indische Culturen (Teysmannia)* (1928, 13, 335).

La Vainilla de Mexico. *Bol. Mens. del Dept. de Econ. y Estad., Sec. de Agric. y Fomento, Mexico* (No. 21, 1928, pp. 29-42).

Une Maladie nouvelle de la Vanille. By A. Maublanc and H. Barat. *Agron. Col.* (1928, 17, No. 123, pp. 77-82).

#### Fodders and Forage Crops

Wildwachsende Australische Futterpflanzen, deren Vermehrung und Verwendung. By D. W. Kolbe. *Tropenpflanzer* (1928, 31, 221-238).

Relative Adaptability of Red-Clover Seed of Different Origins. By R. G. Wiggans. *Bull. 463, Cornell Univ. Agric. Exper. Sta.* Pp. 38, 9 × 5½. (Ithaca, New York: Agricultural Experiment Station, 1928.)

Sweet Clover. By A. J. Pieters. *Leaflet No. 23, U.S. Dept. Agric.* Pp. 8, 9 × 6. (Washington, D.C.: Government Printing Office, 1928.) Price 5 cents.

Wild White Clover. By H. E. Woodman. *Journ. Ministry Agric.* (1928, 35, 74-79).

The Cultivation of Lucerne. By A. Cunningham. *Scottish Journ. Agric.* (1928, 11, 42-50).

Lucerne as a Pasture Plant on Hilly Country. By A. W. S. Moodie. *Agric. Gaz., N.S.W.* (1928, 39, 327-330).

Building up Resistance to Diseases in Beans. By D. Reddick. *Mem. 114, Cornell Univ. Exper. Sta.* Pp. 15, 9 × 6. (Ithaca, N.Y.: Cornell University, 1928.)

The Tangier Pea. By G. K. Baron-Hay. *Journ. Dept. Agric., W. Australia* (1928, 5, 2nd ser., 96-101).

Le riz dans l'alimentation des animaux domestiques (*cont.*). By Heim de Balsac and E. Letar. *Riz et Riziculture* (1927, 2, 211-227; 343-359).

Improved Pastures for Sheep. By J. N. Whittet. *Agric. Gaz., N.S.W.* (1928, 30, 373-378).

Irrigated Pastures. By L. C. Bartels. *Journ. Agric., Victoria* (1928, 36, 111-118).

The Grasslands of New Zealand. Series II. By E. B. Levy. Grasses and Clovers for Hill Country (*cont.*). (6) Brown-top (*Agrostis tenuis*). (7) *Danthonia pilosa*. *New Zealand Journ. Agric.* (1928, 36, 1-18; 297-315).

Nutritive Value of Pasture. III. The Influence of the Intensity of Grazing on the Composition and Nutritive Value of Pasture Herbage (Part I). By H. E. Woodman, D. B. Norman and J. W. Bee. *Journ. Agric. Sci.* (1928, 18, 266-296).

Mineral Content of Pastures. Progress of the New Zealand Investigation. By B. C. Aston. *New Zealand Journ. Agric.* (1928, 36, 22-27; 75-82).

Mineral Content of Pastures. Part I. Studies in Three Pasture Components. By B. C. Aston. *Trans. and Proc. N. Zealand Inst.* (1928, 58, 536-552).

Pasture Top-Dressing Experiments in Otago, Season 1927-28. By R. B. Tennent and A. A. Hume. *New Zealand Journ. Agric.* (1928, 36, 173-183; 245-252).

*Paspalum* Renovation Experiments, Wollongbar Experiment Farm, Lismore, New South Wales. By J. N. Whittet. *Agric. Gaz., N.S.W.* (1928, 30, 119-132).

Grass and Fodder Crop Conservation in Transportable Form. By A. N. Duckham. *Empire Marketing Board Publication No. 8*. Pp. 47, 9½ × 7½. (London: H.M. Stationery Office, 1928.) Price 1s.

Maize Silage, II. By H. E. Woodman. *Journ. Agric. Sci.* (1928, 18, 194-199).

Maize as an English Silage Crop. By H. E. Woodman. *Journ. Ministry Agric.* (1928, 35, 177-181).

Sunflowers for Silage. By E. D. Holden and E. J. Delwiche. *Circ. 220, Wisconsin Agric. Exper. Sta.* Pp. 16, 9 × 6. (Madison, Wisconsin: State University, 1928.)

Coyotillo (*Karwinskia Humboldtiana*) as a Poisonous Plant. By C. Marsh. *Tech. Bull. No. 29, U.S. Dept. Agric.* Pp. 26, 9 × 5½. (Washington: Government Printing Office, 1928.) Price 10 cents.

#### Oils and Oil-seeds

The Castor Oil Plant (*Ricinus* spp.). By S. D. Timson. *Rhodesia Agric. Journ.* (1928, 25, 684-691).

Nuestros Productos de Exportacion. La Higuierilla [Castor Seed]. *Bol. Mens. del Dept. de Econ. y Estad., Sec. de Agric. y Fomento, Mexico* (No. 21, 1928, pp. 21-29).

Wilt Diseases of Coconut Palms in Trinidad (Part I). By H. R. Briton-Jones. Pp. 12, 11 × 8½. *Supp. to Trop. Agric., W.I.* (May 1928).

Die Erdnuss (*Arachis hypogaea* L.). By H. Grunwald. *Tropenpflanzer* (1928, 31, 16-30; 43-58).

Travaux de la Station expérimentale de l'Arachide de Bambey (Sénégal). Campagnes 1924, 1925, 1926. By M. Rambert. *Bull. Comité d'Etudes Historiques et Scientifiques de l'Afr. Occid. Française* (1928, 11, 261-314).

The Oil Palm in Malaya. By B. Bunting, B. J. Eaton and C. D. V. Georgi. *Bull. No. 39, Dept. Agric. F.M.S. and S.S.* Pp. 80, 9½ × 6. (Kuala Lumpur: Department of Agriculture, 1927.)

Travaux de la Station expérimentale du Palmier à Huile de La Mé (Côte d'Ivoire). Partie I. Notes techniques. Cycle 1925-26. 1. Notices individuelles des Palmiers étudiés, by M. Castelli. 2. Formation de la matière grasse au cours de l'évolution des fruits, by M. Lavergne. 3. Fécondation artificielle, by M. Lavergne. 4. Observations biologiques sur les jeunes Elæis, by MM. Lavergne and Blondeau. 5. Recherches technologiques, by M. Lavergne. 6. Étude sur l'influence de la fermentation des fruits avant pressée, by M. Lavergne. 7. Essais sur l'emploi de pressoirs légers en milieu indigène, by M. Castelli. Partie II. Campagne 1926, by M. Castelli. *Bull. Comité d'Études Historiques et Scientifiques de l'Afr. Occid. Française* (1928, 11, 144-249).

Travaux de la Station expérimentale du Palmier à Huile de Pobé (Dahomey). Campagne 1926. By M. Rancoule. *Bull. Comité d'Études Historiques et Scientifiques de l'Afr. Occid. Française* (1928, 11, 250-260).

Données Récentes sur la Culture de Palmier à Huile. By A. Kopp. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 342-352; 410-421).

Contribuição para o estudo botânico da palmeira do azeite em Angola. By J. Gossweiler. *Publ. Diversas X, Missão de Estudos Botânicas, Fomento Geral de Angola*. Pp. 21, 9 × 6. (Lisbon: Agência geral das Colonias, 1928.)

Mededeelingen van het Algemeen Proefstation der A.V.R.O.S. Algemeene Serie No. 33. De Fabricage van Palmolie. By H. N. Blommendaal. Pp. 116, 10½ × 8. (Medan: Verekamp & Co.) Summary in English, pp. 97-116.

Contribution à l'étude du Concassage manuel des noix de palme au Dahomey. By L. Réteaud. *Agron. Col.* (1928, 17, No. 124, pp. 135-137).

Sur l'Emploi des Pressoirs pour l'Extraction de l'Huile de palme. By L. Castelli. *Agron. Col.* (1928, 17, No. 123, pp. 83-93).

The Sunflower (*Helianthus annuus*). By S. D. Timson. *Rhodesia Agric. Journ.* (1928, 25, 281-296).

L'Arbre à Huile de Bois de Chine à Madagascar. By H. Jumelle. *Agron. Col.* (1928, 17, No. 125, pp. 149-153).

#### Essential Oils

The Essential Oils of Two Species of *Bækea*. By A. R. Penfold. (Reprinted from the *Journ. and Proc. Royal Society of New South Wales*, 1927, 61, 285-295.)

The Essential Oil from the Timber of Rosewood (*Dysoxylon Fraserianum*). By A. R. Penfold. (Reprinted from the *Journ. and Proc. Royal Society of New South Wales*, 1928, 61, 337-346.)

The Essential Oil of *Eucalyptus Bakeri* (Maiden). By A. R. Penfold. (Reprinted from the *Journ. and Proc. Royal Society of New South Wales*, 1927, 61, 179-189.)

The Occurrence of a Number of Varieties of *Eucalyptus dives* as Determined by Chemical Analyses of the Essential Oils. Part I. By A. R. Penfold and F. R. Morrison. (Reprinted from the *Journ. and Proc. Royal Society of New South Wales*, 1927, 61, 54-67.)

The Essential Oils of *Eucalyptus micrantha* (de Candolle) and *E. hæmastoma* (Smith). Part I. By A. R. Penfold and F. R. Morrison. (Reprinted from the *Journ. and Proc. of the Royal Society of New South Wales*, 1927, 61, 267-278.)

Les Santals d'Australie et leurs essences. By É. Perrot. *Travaux des Laboratoires de Matière Médicale et de Pharmacie Galénique de la Faculté de Pharmacie de Paris*, tome xviii, année 1927, partie 1e, pp. 1-32. (Paris: Vigot Frères, 1928.) (Reprint from *Bull. Sci. Pharm.*, 1927, 34, 609.)

La Production d'Essence de Térébenthine en Amérique. By J. C. Th. Uphof. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 249-253).

### Fibres

Survey of Textile Industries. Cotton, Wool, Artificial Silk. Part III. *Survey of Industries, Committee on Industry and Trade*. Pp. 328, 9½ × 6. (London: H.M.S. Stationery Office, 1928.) Price 3s. 6d.

Jute (*Corchorus capsularis*—*C. olitorius*). By R. S. Finlow. *Trop. Agric., W.I.* (1928, 5, 104-106).

Les Kapotiers et Succédanés, Culture et Exploitation. By F. Michotte. *Bull. Nos. 1-6, Société de Propagande Coloniale, Section des Cultures Coloniales*. Pp. 82, 9½ × 6½ (Paris, 1927.) Price 15 Fr.

Improvement of *Phormium tenax*. Research on Breeding and Cultivation of the Plant. *New Zealand Journ. Agric.* (1928, 36, 112-115.)

Notes on the Cultivation of Sisal with Special Reference to Ceylon. By G. Harbord. *Bull. 81, Dept. Agric., Ceylon*. Pp. 16, 8½ × 5½. (Colombo: Government Printing Office, 1927.)

La production de l'Alcool d'Agave. By A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 443-445).

Note sur la Sériculture à Madagascar. Suivi d'un rapport spécial sur l'élevage éventuel du ver-à-soie à la Réunion. By H. de Busshère. *Bull. Ag. Gén. des Col.* (1928, 21, 7-11).

Note sur le "Cambodge doré." By E. M. de Flacourt. *Bull. Écon. Indochine* (1928, 31, 41-43).

The Eri or Castor Silk-Worm. *Leaflet No. 46, Dept. Agric., Ceylon*. Pp. 4, 9½ × 6. (Colombo: Government Press, 1927.)

Les Vers à Soie Sauvages du Congo Belges. By E. Michel. Pp. 41, 9½ × 6½. (Bruxelles: Imprimerie Industrielle et Financière, 1928.) Price 10 francs.

### Cotton

Review of the Situation in the Principal Cotton-growing Territories of the Empire, and a Summary of the Main Activities of the Empire Cotton Growing Corporation since their Formation. Pp. 23, 9½ × 6. (London: Empire Cotton Growing Corporation, 1928.)

Annual Report of the British Cotton Growing Association for Year ending December 31, 1927. *Public. No. 101*. Pp. 61 + 9 plates, 8½ × 5½. (Manchester: 1928.) Price 6d.

Report of the Seventh Annual General Meeting of the Empire Cotton Growing Corporation. Pp. 8, 9½ × 6.

Report of the Administrative Council of the Empire Cotton Growing Corporation adopted at the Seventh Annual General Meeting on May 16th, 1928. Pp. 44, 9½ × 6.

Report on Cotton Breeding and Seed Supply in Nigeria. By F. L. Engledow and C. N. French. Pp. 32, 9½ × 6. (London: Empire Cotton Growing Corporation, 1928.) Price 2s.

Les Progrès de la Culture du Cotonnier dans les Colonies françaises. By J. Dybowski. *Coton et Culture Cotonnière* (1927, 2, 89-95).

Progrès de la culture du Cotonnier dans les possessions françaises. By G. Masquelier. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 436-440).

Études sur la culture du coton dans la vallée moyenne du Niger (1922-26). By R. H. Forbes. *Bull. Comité d'Études Historiques et Scientifiques de l'Afr. Occid. Française* (1928, 11, 31-115).

Note sur les Études effectuées de 1922 à 1926 dans la Vallée moyenne du Niger par M. le docteur R. H. Forbes. By E. Belime (*loc. cit.*, pp. 116-137).

Le Coton en Haute-Volta. By E. Hesling. *Actes et Comptes-*



*Rendues de l'Assoc. Colonies Sciences* (1928, 4, 85-91). [Issued with *Rev. Bot. Appl. et d'Agric. Col.*, May 1928.]

Irrigation and Crop Production. By E. McTaylor. *Emp. Cotton Growing Rev.* (1928, 5, 100-112).

Second Report on Cotton Fertiliser Experiments in the Union of South Africa. *Emp. Cotton Growing Rev.* (1928, 5, 165-167).

Fragen aus der Züchtung de Baumwolle. By A. Marcus. *Tropenpflanze* (1928, 31, 127-136).

Bibliographie annotée sur la Conservation en Magasin des Capsules et Graines de Cotonnier. By H. Steece. *Coton et Culture Cotonnière* (1927, 2, 112-125).

Preparation of Cotton for Sale. By H. C. Jefferys. *Rhodesia Agric. Journ.* (1928, 25, 275-280).

Neppiness in Cotton. *Emp. Cotton Growing Rev.* (1928, 5, 97-99).

The Biological Control of Cotton Pests. By J. G. Myers. *Emp. Cotton Growing Rev.* (1928, 5, 113-127).

The Control of Cotton Stainers in Southern Nigeria. By F. D. Golding. *Emp. Cotton Growing Rev.* (1928, 5, 128-133).

The Cotton Bollworm in South Australia. By A. M. Lea. *Journ. Dept. Agric., S. Australia* (1928, 31, 608-615).

*Dysdercus sidiæ* Montr. in Queensland. By E. Ballard. *Bull. Entomological Research* (1928, 18, 405-432).

#### Paper-making Materials

Kraft Pulp and Paper from *Pinus insignis*. By L. R. Benjamin, J. L. Somerville, R. B. Jeffreys and W. E. Cohen. *Bull. No. 35, Counc. Sci., Indust. Res., Commonwealth of Australia*. Pp. 32, 9½ × 6. (Melbourne: Government Printer, 1928.)

Pulping of Annual Grasses, etc., by the Chlorine Process. By J. L. Somerville and L. R. Benjamin. *Journ. Counc. Sci. and Indust. Res., Australia* (1928, 1, 217-226).

Valeur papetière de l'écorce de "Cay-gio" (*Rhamnoneuron Balansæ* [Drake] Gilg.). By F. Heim de Balsac, M. Aribert, G. S. Dagand, A. Deforge, H. Heim de Balsac, J. Maheu and L. Vidal. *Bull. Ag. Gén. des Col.* (1928, 21, 17-36).

Valeur papetière de bois d'Indochine. Fiches Technologiques préliminaires. By F. Heim de Balsac, A. Deforges and H. Heim de Balsac. *Bull. Ag. Gén. des Col.* (1928, 21, 485-498 (cont.)).

#### Rubber

Tables and Diagrams relating to the Rubber Industry. Pp. 16 + 5 charts, 9½ × 6. *Command Paper* 3086. (London: H.M. Stationery Office, 1928.) Price 6d.

Modern Aspects of Rubber Cultivation. By C. H. Wright. *Journ. Roy. Soc. Arts* (1928, 76, 455-506).

Sixth Report of the Executive Committee to the Members of the Rubber Research Scheme, Ceylon. Proceedings during the Year 1927. Pp. 39, 10½ × 8. (Peradeniya: Rubber Research Scheme, 1928).

Field Experimentation with Rubber (*Hevea brasiliensis*). By L. Lord and L. Abeyesundera. *Bull. 82, Dept. Agric. Ceylon*. Pp. 21, 8½ × 5½. (Colombo: Government Printing Office, 1927.)

Soil Erosion, with Special Reference to Rubber. By C. E. A. Dias. *Trop. Agric., Ceylon* (1928, 70, 319-325).

Cover Crops and Green Manuring in Rubber Cultivation. By J. Mitchell. *Trop. Agric., Ceylon* (1928, 70, 325-334).

Some Notes on the Budding of Rubber and the Transport of Budwood. By T. H. Holland. *Trop. Agric., Ceylon* (1928, 70, 335-342).

The Expected Production of Native Rubber in the Dutch East Indies. By A. Luytjes. *Comm. News Bulletin No. 1, Division of Commerce, Buitenzorg*. Pp. 9,  $10\frac{1}{2} \times 8\frac{1}{2}$  (Mimeographed).

Para Rubber in Bataan. By F. G. Galang. *Philippine Agric. Rev.* (1927, **20**, 461-468).

Hevea Stem Disease caused by *Fomes lamarckensis*. By M. Park. *Trop. Agric. Ceylon*. (1928, **70**, 225-226).

Para Nitrophenol for Prevention of Fungal Spots in Crêpe. By T. E. H. O'Brien. *Trop. Agric. Ceylon* (1928, **70**, 238-239).

Notes on Rubber Manufacture. By T. E. H. O'Brien. *Trop. Agric., Ceylon* (1928, **70**, 232-237).

L'Exploitation du Caoutchouc de Funtumia au Cameroun. By L. Hedlin. *Rev. Bot. Appl. et d'Agric. Col.* (1928, **8**, 353-357).

Étude technologique d'écorces de *Funtumia* du Cameroun. Valeur industrielle du caoutchouc qu'elles fournissent. By F. Heim de Balsac, C. Chéneveau, J. Maheu and A. Barveaud. *Bull. Ag. Gén. des Col.* (1928, **21**, 180-186).

### Tobacco

Tobacco Culture in Southern Rhodesia. The Harvesting and Curing of Virginia Tobacco. By D. D. Brown. *Rhodesia Agric. Journ.* (1928, **25**, 255-274).

The Production of Bright Flue-cured Tobacco in America. By G. P. Darnell-Smith. *Journ. Coun. Sci. Indust. Res., Australia* (1928, **1**, 143-153).

Le Tabac aux Indes Néerlandaises. By J. Goubeaux. *Bull. Écon. Indochine* (1928, **31**, 11-40).

A. Overzicht van de uitwerking van organischen mest geconstateerd op de proefvelden, gedurende de jaren 1903-24, aangelegd op verschillende grondsoorten. B. Overzicht van de uitwerking van kunstmest-bijbemesting, geconstateerd op de proefvelden, gedurende de jaren 1903-24, aangelegd op verschillende grondsoorten waarbij vóór het planten organische mest was toegediend. C. Overzicht van de resultaten der proefvelden, over de mogelijkheid van het vervangen van organischen mest door andere meststoffen, op verschillende grondsoorten aangelegd gedurende de jaren 1903-24. By A. N. J. Beets. *Med. No. 59, Proefsta. voor Vorstenlandsche Tabak*. Pp. 127,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Proefstation: 1927.)

1. Tabaksstronken als Stookmateriaal. By W. J. H. Hamming.  
2. Jaarverslag 1 Mei 1925-30 April 1926. By A. d'Angremond. *Med. No. 60, Proefsta. voor Vorstenlandsche Tabak*. Pp. 76,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Proefstation: 1927.)

Rôle Éventuel de la Connaissance des Éléments Anatomiques de la Feuille Sèche des Diverses Variétés de Tabacs dans l'Industrie du Tabac. By J. Chaze. *Rev. Bot. Appl. et d'Agric. Col.* (1928, **8**, 340-342).

The Lesser Tobacco Wireworms. By R. W. Jack. *Rhodesia Agric. Journ.* (1928, **25**, 465-469).

Frenching of Tobacco. By J. C. F. Hopkins. *Rhodesia Agric. Journ.* (1928, **25**, 588-590).

### Drugs

L'Huile de Gorli (*Oncoba echinata* Oliver). Succédané de l'Huile de Chaulmoogra. By D. Jouatte. *Faculté de Pharmacie, Université de Paris, Thèse No. 13*. Pp. 61,  $9\frac{1}{2} \times 6$ . (Issued as *Travaux des Laboratoires de Matière Médicale et de Pharmacie Galénique de la Faculté de Pharmacie de Paris*, tome xviii, année 1927, partie 3e; Paris: Vigot Frères, 1928.)

Le Quebracho-blanco. Étude Pharmacologique. By L. Leprestre.

*Faculté de Pharmacie, Université de Paris, Thèse No. 20.* Pp. 59, 9½ × 6. (Issued as *Travaux des Laboratoires de Matière Médicale et de Pharmacie Galénique de la Faculté de Pharmacie de Paris*, tome xviii, année 1927, partie 5e; Paris: Vigot Frères, 1928.)

La Culture du Quinquina à Java. By G. Frontou. *Agron. Col.* (1928, 17, No. 124, pp. 117-126; No. 125, pp. 162-170).

### Livestock

Annual Report of the Veterinary Department, Northern Rhodesia, for the Year 1927. Pp. 31, 13½ × 8½. (Livingstone: Government Printer, 1928.)

Ticks Infesting Domestic Animals in Southern Rhodesia. By R. W. Jack. *Rhodesia Agric. Journ.* (1928, 25, 537-556; 704-716).

A Study of Ranch Organisation and Methods of Range-Cattle Production in the Northern Great Plains Region. By M. L. Wilcox. *Tech. Bull. No. 45, U.S. Dept. Agric.* Pp. 92, 9 × 5½. (Washington: Government Printing Office, 1928.) Price 20 cents.

State Sanitary Requirements Governing Admission of Livestock. *Misc. Circ. 14, Revised, U.S. Dept. Agric.* Pp. 90, 6½ × 3½. (Washington: Government Printing Office, 1928.) Price 15 cents.

Tropical Dairy Cattle. By H. V. Metivier. *Trop. Agric., W.I.* (1928, 6, 131-133 (cont.)).

Improving Dairy Herds. By J. B. Parker. *Leaflet No. 19, U.S. Dept. Agric.* Pp. 4, 9 × 6. (Washington: Government Printing Office, 1928.) Price 5 cents.

Care of the Dairy Calf. By J. B. Shepherd. *Leaflet No. 20, U.S. Dept. Agric.* Pp. 8, 9 × 46. (Washington: Government Printing Office, 1928.) Price 5 cents.

Feeding Cattle for Beef. By W. H. Black. *Farmers' Bull. No. 1549, U.S. Dept. Agric.* Pp. 16, 9 × 6. (Washington: Government Printing Office, 1928.) Price 5 cents.

Report on the Pork and Bacon Trades in England and Wales. *Economic Series No. 17, Ministry of Agriculture and Fisheries.* Pp. 202 + 11 plates, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 6d.

The French-Canadian Horse. By G. A. Langelier. *Bull. No. 87, New Series, Dept. Agric., Canada.* Pp. 22, 9½ × 6½. (Ottawa: Government Printers, 1927.)

### FORESTRY

#### General

Second British Empire Forestry Conference, held in Canada, July 25 to September 7, 1923. Proceedings and Resolutions, with Brief Descriptions of Tours. Pp. 416, 9½ × 6½. (Ottawa: Government Printer, 1927.) Price \$1.00.

Annual Progress Report of the Administration in Ajmer-Merwara Forests for the Year 1926-27. Pp. 40, 9½ × 6½. (Calcutta: Government of India Central Publication Branch, 1928.) Price Re.1, As.12, or 3s.

Report on Forest Administration in the Andamans for the Year 1926-27. Pp. 78, 9½ × 6½. (Calcutta: Government of India Central Publication Branch, 1928.) Price Rs.6, As.4, or 10s.

Annual Progress Report on Forest Administration in the Province of Bihar and Orissa for the Year 1926-27. By A. J. Gibson. Pp. 70, 13 × 8½. (Patna: Superintendent, Government Printing, 1927.) Price Rs.3, As.4.

Report on the Forest Administration in Burma for the Year ending March 31, 1927. Pp. 226 + 14 plates,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Rangoon : Government Printer, 1928.) Price Rs.5, or 7s. 6d.

Administration Report of the Forest Department of the Madras Presidency for the Year ending March 31, 1927. Vol. I. Pp. 177,  $10 \times 6$ . Price Rs.1.6.0. Vol. II. Pp. 230,  $10 \times 6$ . Price Rs.1.8.0. (Madras : Superintendent, Government Press, 1928.)

Progress Report on Forest Administration in the Punjab for the Year 1926-27. Pp. 33 + cxiii,  $10 \times 6\frac{1}{2}$ . (Lahore : Superintendent, Government Printing, 1928.) Price Rs.7.8.0, or 11s. 3d.

Une exploitation Industrielle des Bois de la Forêt Équatoriale Africaine. By L. Géraud. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 322-333).

Some Aspects of Forestry in Russia. By V. Pelts. *Indian Forester* (1928, 54, 215-225 ; 290-301 ; 349-361 ; 406-411).

Forestry in Sweden. By E. Kekich. *Trade Promotion Ser. No. 56, U.S. Bur. For. and Dom. Comm.* Pp. 27,  $9 \times 6$ . (Washington : Government Printing Office, 1927.) Price 10 cents.

American Forests and Forest Products. Prepared by the Forest Service. *Statistical Bull. No. 21, U.S. Dept. Agric.* Pp. 323,  $9 \times 6$ . (Washington : Government Printing Office, 1928.) Price 45 cents.

Farm-Forestry. IV. The Establishment of Windbreaks, Shelter Belts, and Tree-lots. By R. H. Anderson. *Agric. Gaz., N.S.W.* (1928, 39, 359-367).

Twenty Years' Growth of a Sprout Hardwood Forest in New York : A Study of the Effects of Intermediate and Reproduction Cuttings. By J. N. Spaeth. *Bull. 465, Cornell University Agric. Exper. Sta.* Pp. 49,  $9 \times 5\frac{1}{2}$ . (Ithaca, N.Y. : Agricultural Experiment Station, 1928.)

Management Plans with Special Reference to the National Forests. By I. F. Eldredge. *Miscell. Pub. No. 11, U.S. Dept. Agric.* (Washington : Government Printing Office, 1928.) Price 15 cents.

Timber Growing and Logging Practice in the Lake States. Measures necessary to keep forest land productive and to produce full timber crops. By R. Zon and W. B. Greeley. *Dept. Bull. No. 1496, U.S. Dept. Agric.* Pp. 63,  $9 \times 6$ . (Washington : Government Printing Office, 1928.) Price 20 cents.

A Forest Fire Prevention Handbook for the Schools of Oregon. *Misc. Pub. No. 20, U.S. Dept. Agric.* Pp. 30,  $9 \times 6$ . (Washington, D.C. : Government Printing Office, 1928.) Price 10 cents.

Wirtschaftliches Fällen und Zerschneiden von Bäumen durch Verwendung von Richtigen Handsägen und von Motorsägen. By E. G. Strehlke. *Tropenpflanzer* (1928, 31, 211-221).

Révision des Acacia du Nord, de l'Ouest et du Centre Africain (*cont.*). By A. Chevalier. *Rev. Bot. Appl. et d'Agric. Col.* (1928, 8, 263-270 ; 357-362 ; 432-434 (*cont.*)).

A Note on "Dundathu" Kauri (*Agathis robusta*). By W. R. Petrie. *For. Bull. No. 4, Queensland For. Serv.* Pp. 20,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (Brisbane : Government Printer.)

Bamboo and Bamboo Culture. By B. T. Galloway. *Leaflet No. 18, U.S. Dept. Agric.* Pp. 8,  $9 \times 6$ . (Washington : Government Printing Office, 1928.)

Le Bambou en Indochine. By Capitaine Nicollas. *Bull. Econ. Indochine* (1928, 31, 279-290).

Some Effects of Frost on Sal in the United Provinces. By A. E. Osmaston. *Indian Forester* (1928, 54, 385-400).

The Defoliation of Teak. By C. F. C. Beeson. *Indian Forester* (1928, 54, 204-215).

The East Anglian Timber Willow. By E. R. Pratt. *Journ. Roy. Agric. Soc.* (1927, 88, 80-86).

*Timbers*

Avodiré, ein Nutzholz Westafrikas. By H. Meyer. *Tropenpflanzer* (1928, **31**, 15-16).

The Seasoning of Western Australian Hardwood. With Special Reference to the Structure, Properties and Air and Kiln Seasoning of Jarrah and Karri. By S. A. Clarke. *Bull.* 40, *For. Dept., W. Austr.* Pp. 82, 9½ × 6. (Perth: Government Printer, 1927.)

Prevention of Sap-stain in White Pine (*Podocarpus dacrydioides*). By C. E. Dixon. *New Zealand Journ. Agric.* (1928, **30**, 118-124; 194-200).

The Match Industry in India. *The Indian Forester* (1928, **54**, 271-274).

Umbrella Handle-making Industry. By S. C. Mitter. *Bull.* No. 29, *Indust. Dept., Government of Bengal.* Pp. 8, 9½ × 6½. (Calcutta: Bengal Secretariat Book Depot, 1927.) Price 8 annas or 9d.

*Gums and Resins*

Le benjoin à Sumatra. By J. Goubeaux. *Bull. Écon. Indochine* (1928, **31**, 45-48).

An Experiment in Lac Propagation in the Badami Range, Dharwar-Bijapur Division, Bombay. By S. S. Dhareshwar. *Indian Forester* (1928, **54**, 235-241).

Notes on Lac Cultivation, Bihar and Orissa. By J. H. Lyall. Pp. 32, 9½ × 6½. (Ranchi: Superintendent, Government Printing, Bihar and Orissa, 1928.)

*Tanning Materials*

Les Tanins Végétaux et en particulier les Écorces Tannantes de Madagascar. By H. Chauvel. *Faculté de Pharmacie, Université de Paris, Thèse No. 17.* Pp. 178, 9½ × 6. (Issued as *Travaux des Laboratoires de Matière Médicale et de Pharmacie Galénique de la Faculté de Pharmacie de Paris*, tome xviii, année 1927, partie 4e; Paris: Vigot Frères, 1928; and also as *Notice No. 3, Travaux de l'Association Colonies—Sciences*, Paris, 1927, price 18 Fr.)

Contribution à l'étude des écorces tannifères de Madagascar. By F. Heim de Balsac, A. Deforge, J. Maheu et H. Heim de Balsac. V. Écorce de "Sakoa" (*Sclerocarya caffra* Sond.). *Bull. Ag. Gén. des Col.* (1928, **21**, 12-16; 187-192).

## NOTICES OF RECENT LITERATURE

*Books for review should be addressed to "The Editor, Bulletin of the Imperial Institute, South Kensington, London, S.W.7."*

THE AGRICULTURAL DEVELOPMENT OF ARID AND SEMI-ARID REGIONS, WITH SPECIAL REFERENCE TO SOUTH AFRICA. By H. D. Leppan, Professor of Agronomy, Transvaal University College. Pp. 280, 8½ × 5½. (South Africa: Central News Agency Ltd.; London: Gordon & Gotch, Ltd., 1928.) Price 25s.

As explained by Professor Leppan in his preface, this work "embraces a survey, with special reference to the

drier areas, of the agricultural potentialities of South Africa ; a study of farming development in the arid and semi-arid parts of the Bombay Presidency, Australia and the United States ; an outline of the principles governing farming in regions where production is restricted by aridity ; and a study of the problems confronting the Union with suggestions for the solution of some of these." In the concluding chapter the author submits that from an agricultural standpoint South Africa is " a country of uncertainty, particularly in the arid and semi-arid regions," and " of relatively low potential farming resources."

Although the treatise is admittedly incomplete and in parts rather speculative, it is worth the careful attention of students of economic conditions in the Empire as well as agriculturists in the Union, especially in view of the present indications that mining will play a less important part in South Africa than has been the case in past years and the consequent desirability of making the most of the agricultural possibilities.

PRODUCTS OF THE EMPIRE. By J. Clinton Cunningham, B.A. New Issue. Pp. viii + 299,  $7\frac{1}{4} \times 4\frac{3}{4}$ . (Oxford : The Clarendon Press, 1928.) Price 3s. 6d.

The first issue of this handbook, which appeared in 1920, was reviewed at the time in this BULLETIN (1921, 10, 109), on which occasion a number of serious inaccuracies and omissions were pointed out. Unfortunately these defects are still observable in the present issue, and although it starts with eight pages of " Corrigenda " (a feature hardly likely to increase the reader's confidence) these aim mainly at the bringing up to date of statistical matter. Moreover, as many statistics have been brought up to date in the body of the work, it is difficult to understand why the same procedure could not have been followed throughout.

Among the defects noticeable in the book (some of them additional to those carried over from the earlier issue) may be mentioned numerous botanical, chemical and mineralogical inaccuracies ; the inclusion of Egypt in the British Empire (pp. 88, 201, 266), although correctly classed elsewhere (p. 155) as a foreign country ; references (p. 104) to German East and German West Africa, although such countries no longer exist ; the omission of the Cameroons and Togoland from the list of former German Colonies on p. 289 ; the statement that Tanganyika is an administrative district of the East Africa Protectorate (whereas in fact the latter country is now called Kenya

Colony and Protectorate, and does not in any way include Tanganyika, which is a separate Territory administered by Great Britain under a mandate of the League of Nations); the omission (pp. 198 *et seq.*) of any reference to China as a source of ramie, although that country is practically the only commercial producer of the fibre, which does not come, as the author states, from the West Indies, Queensland or Kenya Colony; and the inclusion in Chapter XVI of graphite and asbestos under the heading of "Metals."

The book makes practically no reference to certain important classes of Empire products, such as gums, resins, essential oils and tanning materials. The arrangement of the subject matter is not always of the happiest, as, for example, the insertion of the section on vegetable dyes between those dealing with coal and petroleum. But the main defect of the work is the persistence of actual inaccuracies even in the new edition.

THE EXTRA PHARMACOPŒIA OF MARTINDALE AND WESTCOTT. Revised by W. Harrison Martindale, Ph.D., Ph.Ch., F.C.S. Nineteenth Edition. Vol. I. Pp. xxxvi + 1207, 6½ × 4. (London: H. K. Lewis & Co., Ltd., 1928.) Price 27s. 6d.

In this first volume of the new edition of this standard work, the excellence of previous editions has been fully maintained. The book has been thoroughly revised, and many new chemicals, drugs, improved preparations and specific remedies have been introduced. Additions have been made to the chapters on vaccines, sera, animal organotherapy, special attention has been devoted to tropical diseases and their treatment, and summaries of the Dangerous Drugs Acts are provided, including the amendments effected by the Dangerous Drugs Regulations of 1926.

It is somewhat surprising to find an account of the manufacture of artificial silk and the methods of applying tests for distinguishing the different varieties of this material, but the authors forestall criticism on this point by stating in the preface that they are sure that "the medical reader will not begrudge the few pages devoted to Cellulose products in view of the industrial importance of the subject."

This remarkably concise compendium of information is invaluable as a work of reference on all matters connected with pharmacy, therapy and allied sciences, and the new edition should find a place on the shelves of all medical men, pharmacists and analysts.

**THE LEATHER TRADES' YEAR BOOK, 1928.** Pp. 220 + i, vi, 9 × 6. (London: The United Tanners' Federation.) Price 7s. 6d.

This Year Book contains particulars of the organisations associated with the leather and allied industries, a directory of British leather producers and their products, and statistics of international trade in hides and skins, tanning materials and leather. In the statistical tables exports and imports by weight and value are recorded with countries of destination and origin respectively. Statistics are also given of livestock, slaughterings and prices of hides and tanning materials in 1927 and in the first three months of 1928. There are three special articles in the book, viz. (1) "Developments in the Chemistry of Leather Manufacture during 1927," by Donald Burton, M.B.E., D.Sc., (2) "Statistics of the American Leather Industry," by Dr. E. C. Snow, and (3) "International Trade in Leather, 1925 to 1927," by P. W. Wilson.

**CONDENSED MILK. A STUDY OF CONDENSED, EVAPORATED AND POWDERED MILK.** By Atsushi Miyawaki, B.S., M.S. Pp. xi + 380, 9 × 5½. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1928.) Price 22s. 6d.

The author of this instructive work is Professor of Dairy Science at the Hokkaido Imperial University in Japan, and is fully experienced in both the theory and practice of his subject. Extensive acquaintance with the science and technology of milk and with the various forms in which the product is placed on the market has enabled him to deal fully with the chemical and technical aspects of the industry, and to present a concise treatise, well written and provided with numerous illustrations, tables and diagrams, which should be of great utility both to students and to those concerned with the preparation and handling of milk products.

**SPRAYING, DUSTING AND FUMIGATING OF PLANTS.** By A. Freeman Mason. Pp. xxxi + 539, 7½ × 5¼. (New York: The Macmillan Company, 1928.) Price 21s.

This work, like many other American handbooks and textbooks, appears to have been produced by exhaustively collecting all the facts available and then attempting to work them into a well-ordered and logically correlated whole. This method may be either a merit or a fault according to the attitude in which the reader approaches the book. To the practical horticulturist or fruit-grower seeking advice in emergency without wishing necessarily



to acquire a grasp of the whole subject in all its details, the structure of the volume may appear inconveniently complex, though such users will no doubt appreciate the various spraying and dusting "schedules," and the "keys" for diagnosing troubles in different crops. For any who wish to study the subject more thoroughly without the necessity of consulting original publications, the book will serve a very useful purpose. It not only deals fully with insecticidal and fungicidal mixtures and the methods of applying them by spraying machines and otherwise, but also contains information on the various pests and diseases affecting a number of fruit and other crops, accompanied by excellent illustrations mostly from photographs supplied by the United States Department of Agriculture.

**ELECTRO-FARMING, OR THE APPLICATION OF ELECTRICITY TO AGRICULTURE.** By A. Borlase Matthews, Wh. Ex., A.M.Inst.I.E., M.I.E.E. Pp. xvi + 357,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: Ernest Benn, Ltd., 1928.) Price 25s.

The author of this work is a well-known advocate of the wider use of electricity in agriculture, who has put his ideas into practice on a farm of 600 acres, which is run on strictly commercial lines. His own practical experience, added to a study of the subject in other countries and of the published literature (the lists of references occupy over 50 pages), has enabled him to produce a treatise which should be of value to all interested in modern farming methods. All aspects of the subject are dealt with, from the generation of electricity in power stations and private plants to its employment for ploughing, harvesting and other agricultural processes, in the homestead, as well as its influence on plant and animal growth.

**GOAT-GRAZING AND FORESTRY IN CYPRUS.** By A. H. Unwin, D.E.C., M.E.F.A., M.C.S.F.E. Pp. 163,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: Crosby Lockwood & Son.) Price 7s. 6d.

It would seem that the problem of living at the public expense has been solved by no class of persons more successfully than by the Cypriot goatherd, whose practice it is to turn his animals out to graze on the property of others and in particular in the forests, where they damage existing trees and prevent the growth of new ones.

Further, the goatherd, it appears, is not above such malpractices as setting fire to portions of the forests in order to make clearings which provide pasturage more to the liking of his goats than the original vegetation.

It will readily be surmised that the author of this book,

who is the Principal Forest Officer of Cyprus, is not favourably disposed towards goats, and a perusal of the volume amply confirms the presumption.

The book is in the main a plea for the protection of the forests from the depredations of these animals. It gives some account of the way in which the goat problem has been faced (or alternatively of the effects of *laissez-faire*) in other countries, it reviews the growth of the evil in Cyprus and the legislative and other attempts that have already been made to deal with it, and it urges the necessity for further action if an important part of the wealth of the Island is to be preserved.

It is pointed out that already the nomad shepherd is being replaced by the farmer permanently attached to his holding. The hope is expressed that further progress will be made in the same direction and that where goats are owned they will be kept under a proper system of animal husbandry to the advantage not only of forestry but also of agriculture. This would lead to an increase in the general prosperity of the population, and also to an improvement in the breed of goats.

FUNDAMENTALS OF BIOLOGY. By Arthur W. Haupt, Ph.D., Assistant Professor of Botany in the University of California at Los Angeles. Pp. xii + 358, 9 × 6. (London : McGraw-Hill Publishing Co., Ltd., 1928.) Price 15s.

In this treatise Dr. Haupt has aimed at presenting, "in a somewhat condensed form, a broad view of the vast biological field, with emphasis upon the fundamental principles common to all living things." He has succeeded admirably in this difficult task, and by judicious selection of examples, and a style which is a model of conciseness and clarity, has furnished a volume which can be unreservedly recommended, both to students commencing the study of biology and to the general reader looking for a really informative epitome of the subject. The author deals with the structure of the cell; with plants and animals of various degrees of complexity, from the lowest to the highest; with metabolism, reproduction, heredity and adaptation, and the bearing of these factors on the problems of evolution; and he has embellished the book with a very excellent selection of diagrams and illustrations.

A TEXTBOOK OF SYSTEMATIC BOTANY. By Deane B. Swingle. Pp. xiii + 254, 9 × 6. (London : McGraw-Hill Publishing Co., Ltd., 1928.) Price 10s.

In this work the author's main object has been to present the fundamental principles underlying the naming

and classifying of plants, an aspect of botany which has seldom, if ever, before been dealt with satisfactorily in a book primarily intended for class use. Nearly half the book, therefore, is devoted to a discussion of such subjects as the principles of taxonomy, difficulties in classification, phylogeny of Spermaphytes, nomenclature and terminology. There is also given an annotated list of the literature on systematic botany, which will be of considerable value to those desirous of making a deeper study of the subject. The second part of the book describes briefly the essential characters of some sixty families of seed-plants, chosen because of their size, economic importance or peculiar interest.

Although the book is written in the main for the American student, the subjects dealt with in the first part are of general application, and the volume can be recommended to all English-speaking students.

THE GEOLOGY OF MALAYAN ORE-DEPOSITS. By J. B. Scrivenor, M.A., F.G.S. Pp. xv + 216, 8 $\frac{1}{2}$  × 5 $\frac{1}{2}$ . (London: Macmillan & Co., Ltd., 1928.) Price 16s.

Mr. Scrivenor's latest work on the geology of Malayan ore-deposits is naturally mainly confined to occurrences of tin ore, although there are chapters on gold, tungsten and other ores.

The work is well illustrated, including a folding geological map of Malaya, and one of the Kinta tinfield. All the principal alluvial and detrital deposits of tin ore are described, including the peculiar lode-like deposit of stanniferous alluvium cemented by calcite of the Jehoshaphat mine—as well as the lodes, stockworks, pipes, stanniferous granites, gneisses, aplites and pegmatites.

Of special interest are the author's present views with regard to the Gopeng Beds, which he formerly regarded as older than the granite, and of glacial origin. He now regards these beds as being younger than the granite, and of detrital origin, although he is still doubtful about the boulder-clays on the west.

As regards the origin of the tin and tungsten deposits, Mr. Scrivenor believes that they were formed by magmatic water charged with various elements in solution. He thinks the media of deposition may have been liquids rather than vapours; but on this question he is doubtful.

With reference to future discoveries of tin, it is pointed out that the areas in the eastern tin-belt that hold out most hope are the granite range separating Trengganu from Kelantan, and the difficult swampy country between the

Pahang and Rompin rivers, and, in the western tin-belt, the main range north of Selangor.

**TIN MINING.** By C. G. Moor, M.A. Pp. xi + 171,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: Sir Isaac Pitman & Sons, Ltd., 1928.) Price 8s. 6d.

This book is written as a guide, and not as a textbook, for all actively interested or engaged in tin mining, and as a guide it fulfils the author's purpose.

The opening chapters are on cassiterite, prospecting for, sampling and assaying tin ore; then follow several chapters on underground mining, mechanical preparation, alluvial tin and alluvial tin mining, and power for mining purposes. One chapter is on the production, smelting, uses, and prices of tin. Most useful are those on the business side of mining, such as the selection of properties, including engineers' reports, the management of mining companies and mines, and mining finance. The last chapter is an interesting historical summary of tin.

The word *shute* is used several times for *shoot*. *Shute* is an incorrect form of *chute*, which is not applicable to a shoot of ore, but to an inclined shoot (*chute*) for ore. The word *addle* is incorrectly used for the Cornish word *atle* or waste rock.

**IMPURITIES IN METALS: THEIR INFLUENCE ON STRUCTURE AND PROPERTIES.** By Colin J. Smithells, M.C., D.Sc. Pp. xi + 157,  $9\frac{1}{2} \times 6$ . (London: Chapman & Hall, Ltd., 1928.) Price 18s.

This book, written by a member of the technical research staff of the General Electric Co. Ltd., will at once appeal to all classes of engineers who are interested in the properties of industrial metals, both in their commercial and pure forms, and their alloys. It may be looked upon as a very satisfactory summary of the present state of our information as to the effects upon the metals of small amounts, generally less than 1 per cent. of the whole, of minor substances—adventitious or otherwise. A knowledge of metallography such as is given in ordinary textbooks is presupposed, although the book is very clearly written and very much can be understood from it without this knowledge.

After giving a summary of the methods of studying the structure of metals, the author in about one-third of the book deals with the X-ray method of analysis and the structure of pure metals and of alloys. The rest of the book treats successively on the influence of minor con-

stituents on metals as regards their structure, mechanical and electrical properties, and corrosion.

The book will repay careful study. It is beautifully printed, and is illustrated with excellent photomicrographs and diagrams.

**BRITAIN'S FUEL PROBLEMS.** Pp. ci + 592, 11 × 5½. (London: "The Fuel Economist," 1927.) Price 42s.

Not only is the cheap production of coal, in view of severe modern competitive conditions, imperative, but it is equally important that every effort should be made to obtain the utmost commercial value from it after it has been produced. The extremely diversified nature of the problems connected with this can be realised by consulting the book under review, which is a veritable encyclopædia of information, quite up-to-date. It has been put together by the efforts of nearly seventy expert contributors, the results in individual chapters being grouped in ten different parts, each issued under the supervision of its own special editor. The subjects dealt with comprise the production and preparation of coal, including its cleaning and briquetting; its utilisation both in the ordinary and pulverised forms both for mechanical and electrical power production in steam plants, and for iron and steel production; the high-temperature carbonisation of coal in all its aspects; complete gasification in gas producers; interior heating; the complete utilisation of fuel, including chapters on such subjects as heat transmission, waste heat recovery, steam accumulators and measuring instruments; refractory materials, and finally, by way of comparison with coal, the production of power from oil, used either by direct firing or in an internal combustion engine. Four articles on fuel economy in the United States, France, Germany and Belgium are contributed by specialists of those countries.

A complete index is provided, this being followed by an illustrated supplement of 80 pages, contributed by manufacturers and by various patentees of processes, a rather unusual but very useful feature. The book should prove of the utmost value to all interested, both directly or indirectly, in fuel problems.

**THE INDUSTRIAL USES OF BAUXITE.** By N. V. S. Knibbs, D.Sc. Pp. 141, 8½ × 5½. (London: Ernest Benn, Limited, 1928.) Price 21s.

Apart from the use of bauxite in the production of aluminium, a number of other uses have been developed

during the last twenty years, and the appearance of this book will be welcomed as it contains a very concise yet complete statement as to the present position of the bauxite industry and its ramifications. The book has been divided into a number of chapters, and although in each of these the matter has been compressed into a small space, it is supplemented with a list of recent references, which should prove very useful to those who wish to go more deeply into the subject.

The first six chapters deal with the general and special occurrences of bauxite in the world, its mining and preparation for the market, its chemical composition with typical analyses and its physical and chemical properties. The remaining seven chapters are more especially devoted to the actual uses of bauxite, and deal with the processes of manufacture, properties and uses of aluminium, aluminous cement, aluminous refractories, aluminous abrasives, alums and other aluminous chemicals, and the use of bauxite in oil refining. In each case the type of bauxite required is indicated. The book concludes with some notes of the future outlook of bauxite, and two useful indexes. In spite of its attractiveness, the price charged for it seems rather high.

### BOOKS RECEIVED

FATS AND OILS, STUDIES OF THE FOOD RESEARCH INSTITUTE, STANFORD UNIVERSITY, CALIFORNIA. No. 1, February 1928. THE FATS AND OILS—A GENERAL VIEW. By Carl L. Alsberg and Alonzo E. Taylor. Pp. viii + 103, 8½ × 5½. Price 4s. No. 2, April 1928. COPRA AND COCONUT OIL. By Katharine Snodgrass. Pp. xiii + 135, 8½ × 5½. Price 6s. (London : P. S. King & Son, Ltd.)

SUGAR BEET IN THE EASTERN COUNTIES, 1927. By R. McG. Carslaw, M.A., C. Burgess, B.A., and G. Ll. Rogers, M.A., with a foreword by J. A. Venn, M.A. *University of Cambridge, Department of Agriculture, Farm Economics Branch, Report No. 9.* Pp. xii + 94, 9½ × 7½. (Cambridge : W. Heffer & Sons, Ltd., 1928.) Price 3s.

THE ROMANCE OF JUTE. A Short History of the Calcutta Jute Mill Industry : 1855-1927. By D. R. Wallace. Second edition. Pp. xiv + 129, 7½ × 4½. (London : W. Thacker & Co.; Calcutta and Simla : Thacker, Spink & Co., 1928.) Price 7s. 6d.

LES VERS À SOIE SAUVAGES DU CONGO BELGE. By Emile Michel. Pp. 41,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Brussels: Imprimerie Industrielle et Financière, Soc. Anon., 1928.) Price 10 frs.

DISEASES AND PESTS OF HEVEA BRASILIENSIS IN THE NETHERLANDS INDIES. By Dr. A. Steinmann. Pp. xii + 42,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (Buitenzorg: Proefstation voor Rubber, 1927.)

THE FOREST INDUSTRY OF FINLAND. By W. E. Hiley, M.A. *Oxford Forestry Memoirs, Number 8*, 1928. Pp. 39,  $11 \times 7\frac{1}{2}$ . (Oxford: The Clarendon Press, 1928.) Price 4s. 6d.

THE USES OF HOME-GROWN TIMBERS. Pp. vi + 36,  $9\frac{1}{2} \times 6$ . *Department of Scientific and Industrial Research, Forest Products Research*. (London: His Majesty's Stationery Office, 1928.) Price 1s.

TESTS OF SOME HOME-GROWN TIMBERS IN THEIR GREEN CONDITION. By C. J. Chaplin, M.Sc., M.E.I.C. *Department of Scientific and Industrial Research, Forest Products Research, Project 1: Progress Report 1*. Pp. iv + 9,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (London: His Majesty's Stationery Office, 1928.) Price 9d.

TESTS OF SMALL CLEAR SPECIMENS. By C. J. Chaplin, M.Sc., M.E.I.C. *Department of Scientific and Industrial Research, Forest Products Research, Project 1: Mechanical and Physical Properties of Timbers*. (London: His Majesty's Stationery Office, 1928.) Price 2s.

DRY-ROT IN WOOD. Pp. vi + 24,  $9\frac{1}{2} \times 7\frac{1}{2}$ . *Department of Scientific and Industrial Research, Forest Products Research, Bulletin No. 1*. (London: His Majesty's Stationery Office, 1928.) Price 1s. 6d.

THE SOILS OF CUBA. By Hugh H. Bennett and Robert V. Allison. Pp. xxiv + 410,  $9 \times 6$ ; with Coloured Soil Map of Cuba and the Isle of Pines,  $25 \times 60$ , and key to the soils, in separate portfolio. (Washington D.C.: Tropical Plant Research Foundation, 1928.) Price \$6.25.

LA MAIN-D'ŒUVRE AGRICOLE AUX COLONIES. By Leon Geraud, Camille Guy and Louis Proust. *Notice No. 4, Association Colonies - Sciences*. (Paris: Association Colonies-Sciences, 44 Rue Blanche, 1928.)

. BRITISH MOSQUITO CONTROL INSTITUTE. Reports presented by the Council and the Director at the Second Annual General Meeting, held at the Hotel Cecil, London, June 18, 1928. (The British Mosquito Control Institute, Hayling Island, Hampshire, England, 1928.)

ANNUAIRE INTERNATIONAL DES MINES ET DE LA MÉTALLURGIE. Edition 1928. By Robert Pitaval. Pp. vii + 768,  $8\frac{1}{2} \times 5$ . (Paris: Société des Publications Minières et Métallurgiques.)

CERAMIC TESTS AND CALCULATIONS. By A. I. Andrews, Ph.D. Pp. viii + 172,  $7\frac{1}{2} \times 5$ . (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1928.) Price 11s.





# REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

*Selected from the Reports made to the Dominion, Colonial  
and Indian Governments*

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## OIL SEEDS FROM BRITISH GUIANA

SAMPLES of crabwood seeds and oil (*Carapa guianensis* Aubl.) and of awarra palm fruits (*Astrocaryum* sp.) have recently been received for investigation at the Imperial Institute from the Forest Department, British Guiana, and the results of their examination are given in the following pages.

### I. CRABWOOD SEEDS AND OIL (*CARAPA GUIANENSIS*)

*Carapa guianensis* is a large forest tree, which yields a valuable timber sometimes marketed under the name British Guiana Mahogany. It occurs chiefly in the forests which border the rivers in the low alluvial flats subject to inundation at high tides, and is predominant in the swamps out of reach of salt water. It also grows on slightly elevated plains and sometimes on hilly lands. The trees are generally scattered through the forests, but are occasionally gregarious, and in one area on the Courantyne River they constitute over 80 per cent. of the total number of trees. The tree also occurs in Brazil, where it is known as "Andiroba."

The seeds yield an oil which is extracted by the natives for use as an illuminant, for medicinal purposes (chiefly as a vermicide and for massage) and as a hair-oil. In order to ascertain the quantity of oil in the seeds and its approximate value in the United Kingdom, a supply of seeds collected from trees on the Barima River, North-West District, British Guiana, and a sample of the locally prepared oil were forwarded to the Imperial Institute.

The seeds received were light brown, of irregular tetrahedral shape,  $1\frac{1}{2}$  to 2 in. in length and  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in. in diameter. Each seed had a thin, brittle, woody shell, enclosing a kernel covered with a light brown, papery skin. The shells formed 29.3 per cent. and the kernels 70.7 per cent. of the entire seeds. Many of the kernels were covered with mould and discoloured internally; the sound kernels had a cream-coloured interior. The average weight of the seeds was 11.7 grams and that of the sound kernels 9.2 grams.

The oil was cream-coloured, partly liquid and partly solid, and possessed an intensely bitter taste. When completely melted the oil was slightly cloudy and was found to contain a trace of insoluble matter.

*Kernels.*—The amounts of moisture and oil in the sound kernels were found to be as follows :

	Per cent
Moisture in kernels . . . . .	6.4
Oil in kernels as received . . . . .	55.0
„ expressed on moisture-free kernels . . . . .	58.8
„ expressed on entire seeds as received . . . . .	38.9

*Oil.*—The following table shows the results obtained on chemical examination of (a) the sample of oil prepared in British Guiana, after filtration at the Imperial Institute, (b) the oil extracted at the Imperial Institute with light petroleum from the kernels of the present sample of seeds, and (c) figures previously recorded for the oil of *Carapa guianensis* :

—	(a) Oil prepared in British Guiana	(b) Oil extracted from kernels at the Imperial Institute	(c) Figures previously recorded	
			(1)	(2)
Specific gravity at 100/15° C.	0.8689	0.8572	—	0.9225 <sup>1</sup>
Refractive index at 40° C . . . . .	1.4590	1.4560	1.4593	—
Solidifying point of fatty acids	37.8° C.	35.8° C	36.2° C	—
Acid value . . . . .	36.9	75.8	37.2	22.6
Saponification value . . . . .	198.5	197.4	197.5	195.6
Iodine value (Hübl, 17 hrs) per cent.	57.3	64.5	62.2	65.0
Unsaponifiable matter, per cent.	1.1	0.7	0.6	—

<sup>1</sup> At 15.5° C.

. The foregoing results show that the sample of seed was of normal character and that the oil prepared in British Guiana and also that extracted from the kernels at the Imperial Institute possessed the usual constants of the oil of *Carapa guianensis*. The acid value of the oil, however, was high, especially in the case of that extracted at the Imperial Institute, the excessive acidity of which was attributable to the poor condition of the kernels.

The seed was not in very good condition on arrival as many of the kernels had become mouldy. It was pointed out that it would be preferable to shell Carapa seeds before shipment and export only sound, well-dried kernels. Such kernels, if offered in commercial quantities and containing as much oil as in the present case, should be saleable in the United Kingdom. The price obtainable, however, would probably not be more than about £12 per ton in London, as the residual cake left after the expression of the oil from the kernels possesses, like the oil, an extremely bitter taste and could therefore not be employed as a feeding-stuff but only as a low-grade fertiliser, for which purpose it would not be worth more than about £4 per ton.

The oil could not be used for edible purposes and could only be employed for soap-making, for which purpose its value would not exceed £30 per ton in London.

The Imperial Institute has recently received enquiries as to the possibility of obtaining supplies of Carapa oil, presumably for use in the preparation of insecticidal washes, and the Forest Department have therefore been requested to furnish information regarding the feasibility of obtaining supplies of the oil or kernels from British Guiana and the price at which they could be offered in the United Kingdom.

## II. AWARRA PALM FRUITS (*ASTROCARYUM* SP.)

This sample of palm fruits was forwarded with a view to ascertaining whether the yields of oil obtainable from the pericarp and kernel would be likely to render the fruits of commercial interest. In this connection it was men-

tioned that the nuts can be easily cracked after drying and the kernels extracted whole.

Specimens of the leaves and fruits were submitted by the Imperial Institute to the Director of the Royal Botanic Gardens, Kew, who reported that they belong (so far as they can be identified) to *Astrocaryum Jauari* Mart. It was mentioned that the name "Avara" of Guiana has been attributed to the species *A. segregatum* Drude, which (like *A. tucumoides* Drude) has the leaflets collected in fascicles along the rachis, whereas in the present specimen the leaflets are solitary.

The fruits were  $1\frac{1}{2}$  to 2 in. in length and 1 to  $1\frac{1}{2}$  in. in diameter, pointed at one end and blunt at the other, and varied in colour from light to dark reddish-brown but in a few cases were almost black. They were somewhat mouldy externally. The lower end of the fruit still bore the perianth.

The fruits had an orange to orange-red fibrous pericarp surrounding the nuts. The nuts, which were dark brown, were from 1 to  $1\frac{1}{2}$  in. in length and  $\frac{3}{4}$  to  $1\frac{1}{4}$  in. in diameter; the shells were woody, and about  $\frac{1}{16}$  in. thick. The nuts mostly contained one kernel each; a few contained two kernels, and some were empty.

The kernels were oval, about  $\frac{3}{4}$  in. in length and  $\frac{5}{8}$  in. in diameter, of brown colour with lighter markings, and creamy white internally.

The average weight of the fruits was 14.1 grams, of the nuts 8.9 grams and of the kernels 3.2 grams. The fruits were composed of pericarp and perianth 37.0 per cent., shell 39.8 per cent. and kernel 23.2 per cent. The nuts consisted of shell 63.2 per cent. and kernel 36.8 per cent.

The table on p. 415 gives the results of the examination of the pericarp (including the perianth), the kernels, and the oils respectively obtained from them. The constants of the kernel oil are shown in comparison with figures recorded by previous investigators for the kernel oil of *A. Jauari* Mart.

The oil from the pericarp, as extracted with light petroleum, was orange-red and partly solid at temperatures of about 60° F. It possessed a slight odour somewhat resembling that of palm oil.

—	Pericarp.	Kernels.	
		Present sample.	Figures previously recorded.
Moisture . . . . . <i>per cent.</i>	7.4	16.0	—
Oil, in material as received . . . . . <i>per cent.</i>	45.5	36.3	—
Oil, in moisture-free material . . . . . <i>per cent.</i>	49.1	43.2	—
<i>Constants of Oil</i>			
Specific gravity at 100/15° C. . . . .	0.8573	0.8660	0.9159 <sup>1</sup>
Melting point . . . . .	—	30.8° C.	30.5° C.
Refractive index at 40° C. . . . .	1.458	1.4505	1.4510
Acid value . . . . .	38.4	0.4	5.39
Saponification value . . . . .	195.8	241.9	241.96
Iodine value (Hübl, 17 hrs.) . . . . . <i>per cent.</i>	68.0	14.6	12.71
Unsaponifiable matter . . . . . <i>per cent.</i>	0.5	0.5	0.65
Soluble volatile acids . . . . .	0.4	2.4	1.05
Insoluble volatile acids . . . . .	0.2	6.8	—
Solidifying point of fatty acids . . . . .	36.7° C.	27.0° C.	23.5° C.

<sup>1</sup> At 15/15° C.

The kernel oil, as extracted with light petroleum, was a cream-coloured, hard, solid fat, with a slight odour resembling that of coconut oil. It will be observed that the constants of the present oil agreed very closely with those previously recorded for *A. Jauari* kernel oil, the only important difference being in the solidifying point of the fatty acids.

With regard to the commercial value of the products from Awarra palm fruits, the following observations may be made.

*Fruits.*—It seems unlikely that the entire fruits could be profitably exported owing to the large proportion of shell and the fact that the oil in the pericarp would tend to become rancid during transit.

*Oil from pericarp.*—This product would be suitable for the same purposes as palm oil derived from the African oil palm (*Elaeis guineensis*), the current price of which is about £34 per ton in Liverpool. The pericarp of these Awarra fruits yields, however, considerably less oil than that of the fruits of the African oil palm, which contain from 66 to 73 per cent., and it is a question for local consideration whether the oil could be remuneratively prepared for shipment to the United Kingdom in competition with African palm oil.

*Kernels and Kernel Oil.*—Awarra kernels should be saleable in the United Kingdom, but they contain less oil than West African palm kernels (*Elaeis guineensis*), with which they would have to compete, and would therefore realise a lower price, probably about £14 per ton in Liverpool with West African palm kernels at £20 to £21 per ton. The kernel oil could be used, like ordinary palm kernel oil, for edible purposes, and should be of about the same value, viz. £37 to £37 10s. per ton in Liverpool at the present time. The residual cake or meal should be suitable for use as a feeding-stuff, but as these products from *Astrocaryum* kernels generally contain less protein than commercial palm kernel cake or meal their value might be somewhat lower. Palm kernel meal is now selling at £9 per ton in the United Kingdom (July 1928).

The results of this investigation indicate that it is unlikely that Awarra fruits could be profitably shipped to the United Kingdom, but that the kernels and the kernel oil should find a market. The oil obtained from the pericarp would have to compete with ordinary palm oil and might not be worth extraction for export.

The Imperial Institute is making enquiries as to the possibility of obtaining commercial consignments (50 to 100 tons) of the Awarra kernels for shipment and also as to the prospects of preparing the pericarp oil for export.

## A NEW OIL SEED FROM BRAZIL

IN view of the interest that British oil-seed crushers take in possible new sources of oil, it has been thought desirable to publish the results of the examination of a sample of nuts which was sent recently to the Imperial Institute by Dr. Eurico Teixeira da Fonseca of Rio de Janeiro. The nuts were stated to be those of *Joannesia heveoides* Ducke (natural order Euphorbiaceæ) and are known in Brazil as "Castanha de Arara." A previous sample of Arara nuts apparently representing the same species was examined at the Imperial Institute in 1924.

. According to Dr. Teixeira's "Oleos Vegetaes Brasileiros," *J. heveoides* is a large tree occurring in the Oyapoe region and the middle Tapajoz River district. The fruit is a three-celled, dehiscent capsule, with a single seed ("nut") in each chamber, and closely resembles that of *Hevea brasiliensis*, but is much larger. The fruit ripens from December to April.

The sample forwarded by Dr. Teixeira consisted of large, dark brown, oval nuts (seeds), from 2 to  $2\frac{1}{2}$  in. in length and from  $1\frac{1}{8}$  to  $1\frac{7}{8}$  in. in diameter; the shell had a thickness of  $\frac{1}{16}$  to  $\frac{1}{8}$  in. The nuts were composed of shell 55.2 per cent. and kernel 44.8 per cent. The average weight of the nut was 53.8 grams and that of the kernel 24.1 grams, as compared with 59.7 and 27.6 grams respectively in the case of the earlier sample.

The kernels were found to contain 4.6 per cent. of moisture, and to yield, on extraction with light petroleum, 58.6 per cent. of oil, corresponding to a yield of 61.4 per cent. expressed on the moisture-free kernels. The kernels of the Arara nuts examined in 1924 contained 6.0 per cent. of moisture, and furnished 57.3 per cent. of oil, equivalent to 61.0 per cent. in the moisture-free kernels.

The oil as extracted by light petroleum was a pale yellow liquid, with a pleasant nutty odour. It was found to have the following constants, to which are added for comparison those obtained for the earlier sample:

	Present sample.	Previous sample.
Specific gravity at 15/15° C. . . . .	0.9239	0.9242
Refractive index, $n_D^{20}$ C. . . . .	1.467	1.469
Acid value . . . . .	2.1	0.4
Saponification value . . . . .	188.5	191.6
Iodine value (Hübl, 17 hrs.) . . . . .	per cent. 129.8	130.4
Unsaponifiable matter . . . . .	per cent. 0.48	0.5

A thin film of the oil exposed on glass required 11 days to dry, as compared with 12 days for the sample examined in 1924 and 8 days for linseed oil.

The residual meal, left after extraction of the kernels with light petroleum, was a pale cream-coloured powder, with a faintly bitter taste, and an odour somewhat resembling that of castor oil. It was analysed with the following results, which are shown in comparison with



those obtained for the residual meal from the Arara-kernels examined in 1924 :

	Present sample Per cent	Previous sample Per cent
Moisture . . . . .	8.0	10.7
Crude proteins . . . . .	47.4	44.5
Fat . . . . .	0.7	1.1
Starch, etc (by difference) . . . . .	25.1	27.0
Crude fibre . . . . .	6.5	6.5
Ash . . . . .	12.3	10.2
<hr/>		
Nutrient ratio . . . . .	1 0.56	1 : 0.66
Food units . . . . .	145	141

The meal was found to contain a substance or substances of an alkaloidal nature.

From the foregoing results it will be seen that *Joannesia heveoides* kernels furnish a high percentage of an oil which could be readily employed in soap-making. The oil has " semi-drying " properties and might possibly be of use, after " boiling," for paint-manufacture in admixture with linseed oil. Owing to the fact that the kernels may perhaps possess toxic properties it is doubtful whether the oil, as obtained by expression, could be employed for edible purposes, and physiological trials would be necessary to determine this point.

The residual meal, which is rich in protein and contains only a small amount of crude fibre, resembles soya bean meal in general composition. As, however, it appears to contain substances of an alkaloidal character it could not be employed as a cattle food unless preliminary experiments had proved it to be innocuous.

## COFFEE FROM MAURITIUS, SIERRA LEONE AND SUDAN

### I. MAURITIUS

SMALL areas of coffee have been cultivated for many years in Mauritius, where the higher lands are well suited to the crop. Hitherto it has been grown entirely for local consumption, but with a view to ascertaining the suitability of the produce for export a sample of Liberian coffee grown in the island was forwarded to the Imperial Institute in May 1928.

The sample consisted of ungraded coffee in good clean condition. It was composed of large, cream-coloured beans, opaque internally, many of which were partly covered with a pale brown, tightly adhering seed-coat.

On examination it was found that the average weight of a bean was 0.29 gram. The coffee was submitted to chemical analysis with the following results :

	<i>Per cent</i>
Moisture . . . . .	10.7
Crude proteins . . . . .	12.2
Caffeine . . . . .	1.4
Fat . . . . .	10.4
Carbohydrates, etc (by difference)	50.6
Crude fibre . . . . .	10.9
Ash . . . . .	3.8
Hot water extract . . . . .	30.6

These results show that the coffee is of satisfactory composition.

Portions of the sample were submitted to two firms of brokers for their opinion as to its quality and commercial value, and the following reports were received :

(1) " We have examined this sample and find the same to be a good quality Liberian of bold size : smooth, lightish to yellowish, well picked and, in our opinion, comparing very favourably with the best Liberian coffees from other countries, and we estimate the present approximate valuation to be 100s. per cwt. landed London.

" Such coffee should generally find ready buyers in our market for export to other countries, but is not in demand for our own Home Trade."

(2) " It is fine, bold, yellow-washed, rather fancy coffee ; the nominal value is about 100s. to 105s. per cwt., London spot terms. We have not seen any Liberian so fine for some time, and if it is possible to grow up to the standard of your sample, we feel sure it would usually sell readily here, although, naturally, it would be subject to market fluctuations."

The results of this investigation have shown that this Liberian coffee was of normal composition and of good appearance and quality, and that such coffee, although not in demand for consumption in the United Kingdom, would usually be readily saleable in London for export

to the Continent. It therefore appears that the cultivation of the coffee might well be extended in Mauritius with a view to the establishment of a small export trade.

## II. SIERRA LEONE

At one time the production of coffee in Sierra Leone was of some importance. A wild coffee, *Coffea stenophylla*, is found in many parts of the Protectorate, especially in the Kessewe Hills, near Yonnibanna in the Northern Province. At lower altitudes, at the foot of the Colony mountains, Liberica and Robusta coffees are found in some of the villages, whilst Liberica coffee has also been grown for many years in the eastern part of the Southern Province.

According to *Pamphlet* No. 11, issued by the Division of Agriculture of the Lands and Forests Department ("Hints on the Cultivation and Preparation of Coffee in Sierra Leone"), the coffee plantations in the Colony have been considerably neglected in recent years, resulting in some cases in the total loss of the trees. Even where the trees have survived the yields are poor and the quality inferior to that of the coffee formerly produced. Most of the coffee grown is consumed locally, but there is a small export chiefly to neighbouring countries. In 1927 8,687 lb. of coffee were exported, of which 2,835 lb. were sent to Germany and the remainder to French Guinea, Gambia and Liberia.

With a view to encouraging the farmer to produce a coffee of better quality the pamphlet mentioned above was issued in 1923, and subsequently a large number of nurseries for raising plants were established by the Department at various towns and villages. The Robusta type is being encouraged in the Ghangbama District in the west of the Southern Province and the Liberica type in the Pujehun and Mano River Districts in the east of that Province. In the Central Province a small area has been planted with *Canephora* coffee on the lower slopes of the Moyamba Hills, whilst *Stenophylla* coffee is being encouraged in certain tracts of the Northern Province. In addition to this work, the Department are carrying out trials with different varieties of coffee at each of the provincial experimental farms.

With a view to ascertaining the quality and market value of the locally grown coffee in comparison with Robusta coffee from other sources, a sample of mixed Java and Congo types of Robusta coffee was sent to the Imperial Institute from Sierra Leone in May 1928.

The sample consisted of ungraded coffee beans, freed from parchment, and of very irregular size. The beans were cream-coloured and opaque, and had been well cleaned.

The coffee was chemically examined with the following results, which are shown in comparison with the corresponding figures obtained at the Imperial Institute for samples of Robusta coffee from Tanganyika and Ceylon :

—	Present sample	Native Robusta coffee from Tanganyika	Robusta coffee from Ceylon.
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent.</i>
Moisture . . . . .	10·4	9·8	10·1
Caffeine . . . . .	1·3	2·2	2·1
Proteins . . . . .	10·3	10·3	13·4
Fat . . . . .	10·1	10·6	6·7
Carbohydrates, etc. (by difference)	48·6	49·4	49·6
Crude fibre . . . . .	15·7	13·4	14·6
Ash . . . . .	3·6	4·3	3·5
Hot water extract . . . . .	29·0	33·1	—

These results show that the sample was of normal composition, except that the amount of caffeine was somewhat lower than usual.

The coffee was submitted to two firms of brokers in London, who furnished the following reports :

(1) " Having carefully examined the sample, we find same to be distinctly inferior in the raw to the general run of Robustas produced in other countries, but about equal in roast and somewhat inferior in liquor to the average from other sources. We estimate the present market value of the sample to be about 80s. per cwt., London landed terms."

(2) " We have carefully examined this coffee, and find that it is rather unsuitable for the home trade. However, if it were sold in London it would be readily saleable by exporters to the Continent. The quality, when compared with Java Robusta and Uganda Robusta, is somewhat inferior, it being rather more ragged and rough in

appearance and more uneven in size. The liquor would also be a little below the requisite standard of quality for home use.

"At present the approximate value in London would probably be about 75s. per cwt., if sold in quantity. Java Robusta prices range from 88s. to 92s. per cwt. and a fair business is done here, a good proportion being exported to Holland. Uganda Robusta is usually well competed for by the home trade buyers and values are about 80s. to 84s. per cwt. at the present time."

This sample was not equal in quality to the commercial supplies of Robusta coffees from other countries, but nevertheless such coffee would probably find a market in London, principally for disposal on the Continent. The beans were not well formed and were of very irregular size, but the latter defect could be remedied by grading.

If the quality could be improved and consignments offered at prices such as those quoted above, the production of the coffee on a commercial scale in Sierra Leone would appear to be worth consideration.

### III. SUDAN

The coffee which is the subject of this report was received at the Imperial Institute in February 1928. It was stated to represent Abyssinian coffee cleaned by hand at Khartoum, and it was desired to learn its quality and market value in comparison with Brazilian coffee.

The sample consisted of ungraded coffee, the beans varying in size from small to fairly large; a few beans were still in the parchment or in berry and a few pea-berries were present. The beans were greyish-cream and opaque and had an average weight of 0.15 gram; a few were shrivelled and discoloured.

The sample contained a small quantity of broken husk, but was practically free from earthy matter.

The coffee was submitted for valuation to brokers in London, who after examining and testing the sample, reported that it was slightly below the usual standard of Abyssinian coffee received in the United Kingdom, but should be worth about 95s. to 97s. per cwt. at the present time, landed in London. As regards comparison

with Brazilian grades, the firm stated that corresponding prices now ruling are 105s. to 107s. per cwt. for average quality Superior Santos and 80s. to 82s. per cwt. for Superior Rio coffee.

The firm added that the outlet in the United Kingdom for coffee of this type is as a rule comparatively small, except on a very firm market. There is, however, a demand for it in France and other Continental countries, and the firm were of opinion that an export of 4,000 tons per annum could be absorbed without difficulty. They mentioned that such coffee arriving in London usually comes on consignment and that they would be willing to find purchasers, for either the home or Continental market, for any shipments which might be forwarded.

It will be seen that coffee of the quality of the present sample should be saleable in London and that the current price would probably be slightly below that ruling for the best Abyssinian, and between that of the Superior Santos and Superior Rio grades from Brazil. The use of cleaning and sorting machinery would ensure a better product and it would be advisable to employ such methods, rather than to resort to hand cleaning, if it is decided to export the coffee on a commercial scale.

The Sudan authorities have been informed that if so desired the Imperial Institute will be glad to assist in the marketing of trial shipments of the coffee in London.

#### DRIED LITCHIS FROM MAURITIUS

THE litchi, letchi or lychee (*Litchi chinensis* Sonn. = *Nephelium Litchi* Gamb.), is a small to medium-sized tree belonging to the natural order Sapindaceæ. It is a native of South China and is largely cultivated in that region for the sake of its fruit, which is one of the most highly esteemed of the many fruits grown in that country. Although considered most attractive when fresh, fairly large quantities of the fruit are exported from China in the dried state and some, preserved in syrup, reach the United States. The plant has been introduced into many other parts of the tropics, including India, Australia, South Africa, West Indies and Brazil.

In Mauritius the litchi has been found to thrive exceedingly well. There are already many thousands of bearing trees in the Colony and the number is increasing at the rate of about 200 to 300 per year. Owing to this rapid increase it is anticipated that in due course the supply of fruit may exceed the consuming capacity of the Colony. A sample of the dried fruits was therefore sent to the Imperial Institute recently in order to ascertain whether a market could be found for them in England, and if so its probable extent and the prices likely to be realised.

In view of the contemplated establishment of a small fruit-canning industry in Mauritius it was also desired to learn whether there would be a sale in the United Kingdom for litchis preserved in syrup.

The sample consisted of egg-shaped fruits, varying from 1.25 to 1.6 in. in length and from 1.0 to 1.25 in. in diameter. They were in good condition.

The shells were pale reddish-brown, thin and brittle and covered with small wart-like protuberances. The pulp of the fruit was soft, dark reddish-brown and somewhat shrivelled, and was attached to a tough skin which covered a large, hard, chocolate-coloured seed. The skin, with the pulp attached, could be easily peeled off the seed. The pulp had a pleasant, raisin-like taste.

The average proportions of shell, pulp and seed in the fruits were as follows: shell 20.7 per cent., pulp 48.9 per cent., seed 30.4 per cent. The average weight of one fruit was 5.64 grams, consisting of shell 1.17 grams, pulp (including skin) 2.76 grams, and seed 1.71 grams. The seeds varied in length from 0.8 to 1.0 in. and in width from 0.5 to 0.8 in.

The litchis were submitted to two firms of merchants in London who were asked whether there would be a market for the dried fruits in the United Kingdom, and if so its probable extent and the prices likely to be obtainable. One firm stated that small experimental consignments of dried litchis have been made to this country from China. They considered it to be doubtful whether large shipments could be marketed except at a low price, but stated that there would appear to be promising prospects for small consignments if they could be supplied at a price which

would enable them to be sold retail at about 1s. per lb. They suggested that the fruits might be packed in boxes containing either 10 lb. or 20 lb., but expressed the opinion that it would be more satisfactory for them to be packed in cases containing 24 cartons of  $\frac{1}{2}$  lb. each. They added that the last experimental shipment from China, packed in attractive chests, realised from 1s. to 1s. 3d. per lb. wholesale. The firm stated that they would be glad to take charge of any consignments which producers in Mauritius might wish to forward to this country.

The same firm were asked whether they considered that there would be likely to be a market in the United Kingdom for litchis preserved in syrup. They replied that they had not heard of such a product being shipped to this country, but that provided the cost of production is not excessive they saw no reason why a demand should not be created.

The second firm stated that they sell large quantities of dried litchis, the price varying from 9d. to 3s. per lb., largely according to the month in which they come on to the market. The dried fruit comes chiefly from China, but considerable quantities of the fresh fruit are now arriving from the Cape. The latter are stated to be of good quality, the pulp being similar to that of a cherry, and sell at about 2s. per lb. This firm stated that the litchis from Mauritius (represented by the sample) are apparently not of the best variety as they contain large stones, whereas in litchis of good quality the stones should be very small. They mentioned, however, that the size of the stones varies a good deal in any one consignment and they consider it not unlikely that small- and large-stoned fruit may occur on the same tree or on the same group of trees. They expressed the opinion that an effort should be made to grow a variety with the least possible percentage of stone.

They added that they would be pleased to receive information regarding any consignments which may be forwarded and that they would be willing to purchase them.

It is evident from the foregoing report that the dried litchis would find a market in the United Kingdom, and



it would therefore be worth while for a trial consignment of a few cwts. to be forwarded for sale to the firms mentioned. The authorities were informed that the Imperial Institute will be glad to be of any assistance in this connection.

It is also possible that a market might be created for the litchis preserved in syrup, and it has therefore been suggested that in the first instance samples of the fruit prepared in this form should be forwarded to the Imperial Institute for submission to the trade.

## NOTES

**Empire-grown Sisal.**—Increasing supplies of sisal hemp are now becoming available in East Africa and other parts of the British Empire and in order to direct the attention of manufacturers to this source of supply the Empire Marketing Board have just issued a pamphlet entitled "Empire-grown Sisal and its Importance to the Cordage Manufacturer." The pamphlet has been prepared by the Imperial Institute with the co-operation of its Advisory Committee on Vegetable Fibres, and deals with the qualities of the fibre, its cultivation and preparation, and production in British countries. Copies are obtainable from H.M. Stationery Office or through any bookseller, price 6d.

**Tobacco from Uganda.**—In the previous issue of this BULLETIN (p. 291) a report was published on the examination at the Imperial Institute of two samples of tobacco prepared experimentally in Uganda. In view of the good quality of the leaf, the following particulars regarding the experiments may be of interest (*Annual Report of the Department of Agriculture, Uganda, 1927*).

The experiments were conducted with heavy types of tobacco suitable for fire-curing, such as might be grown and cured by natives. Bulindi, in Bunyoro District, was selected as a suitable place in which to carry out the work, as it is a fairly large centre for natives and it was hoped that they would take some interest in the trials and benefit by the demonstration of the cultivation and handling of the crop in all its stages. This hope seems to have been justified to some extent, judging by the number of requests received for seeds and plants this season.

Two acres of land, near the Hoima-Masindi, were used

for the experiments, and the work of clearing and opening up the land was commenced at the beginning of February 1927. Nurseries were sown on February 10, the seed used being a heavy type of Virginian tobacco, which had been grown at the Serere Experimental Station for some years, and a South African variety, "Piet Retief Swazie," the seed of which came from the Department of Agriculture, Pretoria. Grass was used for shading the beds and proved quite satisfactory. Germination was excellent, the young plants showing up well on the seventh day. With the exception of a slight attack of stem-borer, *Phthorimæa heliopa*, no trouble was experienced in the nurseries. The beds were sprayed on three occasions with Burgundy mixture, with the exception of two beds which were left unsprayed as controls. No leaf diseases were observed on either the sprayed or unsprayed plants, but in view of the presence of several diseases on plots of native tobacco it is considered advisable that spraying should form a regular part of the work carried out in tobacco nurseries.

The main planting of the tobacco was carried out on April 21, planting being done on the flat with a spacing of 3 ft.  $\times$  3 ft. Growth was rapid owing to the excellent weather conditions prevailing during May and June, and the plants were ready for topping at the end of the latter month. An average of nine leaves was left on each plant.

Harvesting commenced on July 14 and was completed on July 25, the single-leaf method of picking being used throughout. The leaf was of good average size, heavy and oily. Curing was effected in a grass shed by the open-fire method, the average time taken to cure and dry each picking being 30 days. The cured leaf was of good colour with fair body and texture.

From the two acres planted, 1,490 lb. of cured leaf was obtained, of which 800 lb. was of first grade (D.L.).

A second sowing was made on July 29. Germination was good and the plants were ready for putting out at the end of September. It was anticipated that, owing to unfavourable weather conditions during the next three months, the crop would be a poor one (see p. 475). It is considered, however, that under normal conditions two crops may be obtained during the year.

In addition to these experiments with heavy tobaccos, trials with flue-cured cigarette tobacco were carried out on a European plantation near Masindi and also on land near Hoima. Owing to difficulties experienced in constructing suitable flues, the curing could not be completed, but it is stated that the experiment as far as it could be carried through showed great promise of success, and that

there is little doubt that tobacco of a good yellow colour can be grown on the lighter soils of the district.

**English-grown Pyrethrum as an Insecticide.**—An interesting article under this title by J. C. F. Fryer, F. Tattersfield and C. T. Gimingham has appeared in *Annals of Applied Biology* (1928, 15, 423). It records the results of an investigation undertaken by the Department of Insecticides and Fungicides, Rothamsted Experimental Station, on the cultivation of pyrethrum in this country, with particular reference to the type of soil best suited to it and the possibility of the occurrence of variation in toxicity in the flowers grown in different localities. It was also desired to obtain information regarding the keeping qualities, the variation, if any, of toxicity with size of flower-head, and as to whether or no any specificity of toxic action is shown.

From pyrethrum (*Chrysanthemum cinerariæfolium*) seed obtained from both Switzerland and Japan, plots were grown on various types of soil at different agricultural stations throughout the country. The plant is a perennial which under English conditions requires rather more than a year before it comes into full bearing. At Harpenden the best results were obtained by sowing in the autumn, the young plants being wintered in cold frames and planted out in the following spring at a distance of 18 in.  $\times$  18 in. By the following autumn the plants were beginning to touch, and in the second summer after sowing, when the first crop was taken, the ground was completely covered. The plants were found to withstand well the English winter, and the oldest plot has so far furnished two harvests with good prospects of at least a third. It is considered improbable, however, that plantations in England will last from eight to nine years as they do in France.

The harvesting consists of cutting the flowers with about 8 in. of stalk, and then removing the flower-heads either before or after drying, which is carried out first in the open when sunny, and then in a ventilated building, the flowers being spread in thin layers. After drying for about 6 weeks the flowers can be safely stored in metal bins or tins. In the case of the majority of the plots the flowers were cut when the petals were fully developed but before they had flattened out.

Some flowers, however, were collected at an earlier stage and were examined for toxicity at various stages of development in order to ascertain whether, as commonly supposed, the almost closed buds were the most effective. The average yield from plots grown at Harpenden in

.1927 from Swiss seed was 3 lb. 14 oz. per rod. A conservative estimate of the yield in France is given as about 2.5 lb. per rod.

In carrying out the toxicity tests, alcoholic extracts of the ground flowers were made under constant conditions and diluted with an aqueous 0.5 per cent. solution of saponin to different known concentrations, and the toxicity of these solutions, principally to the black bean aphid (*Aphis rumicis*), determined by spraying. Control tests were conducted with similar amounts of alcohol and saponin. Alcohol itself was found to be non-toxic at concentrations considerably higher than those used in these tests. The action of pyrethrum on *A. rumicis* is extremely rapid, producing a state of profound narcosis, which at the higher concentrations results in death but at lower concentrations may wear off and the insects more or less recover from its effects. The results of the determinations of the toxicity of the flowers grown at different centres showed only small variations, and for practical purposes all the samples were considered to have the same toxicity to *A. rumicis*. The samples grown from Swiss and Japanese seed showed about the same toxicity, and did not differ significantly in this respect from a sample grown in France. Concentrations of 0.5 per cent. proved fatal in every case, and with those of 0.1 per cent. generally between 70 and 100 per cent. of the insects were killed or rendered moribund. Experiments were also carried out with the larvæ of several species of lepidoptera with results which showed marked differences in their susceptibility to the action of pyrethrum. In the case of the larvæ of the vapourer moth (*Orgyia antiqua* L.) the toxic action was extremely rapid, whilst larvæ of the cabbage moth (*Barathra (Mamesta) brassicæ* L.) on the other hand showed themselves highly resistant.

In view of the commercial importance of selecting a right time for harvesting the flowers, a number of flower-heads at different stages of development were chosen from plants grown at Harpenden from Swiss seed, and their toxicity at each stage determined. The stages at which the samples were collected, and the weights of air-dried flower-heads per 100 are shown in the following table :

Degree of Development.	Weight of 100 air-dried flower-heads grams.
Closed . . . . .	8.8
Slightly open . . . . .	14.0
Half open . . . . .	14.75
Fully open . . . . .	20.5
Very fully open . . . . .	21.6

The results obtained clearly indicated that little difference exists between the toxicity of the various samples, weight for weight, and the differences observed could not be regarded as outside the error of experiment. Tests as to the comparative toxicity of different parts of the plant showed that the flowers were more than ten times as toxic as the flower stalks, weight for weight, and that the ray corollæ were not toxic, but that the disc corollæ were apparently rather more toxic than the stalks.

It was ascertained that artificial drying of the flowers—a procedure which might have to be resorted to in a wet summer—resulted in no material loss of toxicity. Experiments were moreover carried out to determine the effect of exposure on the toxicity of pyrethrum and several drastic tests were made. In one of these, where some loss in toxicity was indicated, a sample of the ground flowers was exposed for six months under open-air conditions, but with protection from direct rain and snow. The tests made clear, however, that if stored in a reasonable manner pyrethrum remained for long periods without deterioration.

The authors have shown, therefore, that pyrethrum can be successfully grown and harvested in England, that the flowers have the same insecticidal value as those grown abroad, and that, contrary to the usual opinion, the toxicity of the flowers differs very little at various stages of development. Moreover, they can be stored for a considerable time before any deterioration in their value takes place. The biological method adopted has proved very successful for evaluating the samples examined, and has been used for the detection of pyrethrum extracts in insecticidal material of unknown composition.

Pyrethrum has been the subject of much chemical investigation with a view to the isolation and characterisation of its active principles. It is only recently, however, through the extensive researches of Staudinger and Ruzicka (*Helv. Chim. Acta*, 1924, 7, 177), that its toxic properties have been shown to be due to two constituents, pyrethrin I and pyrethrin II, the complex constitution of which these authors claim to have established. These compounds were found to be present in the flowers examined to the extent of 0.2 to 0.3 per cent. Pyrethrin I is the more active, and killed cockroaches at a dilution in an inert powder of 1 in 10,000 in 10 to 20 minutes, whilst pyrethrin II took twice as long to produce the same result. More recently, Staudinger and Harder have devised two methods for the estimation of pyrethrin I and II (*Ann.*

*Acad. Scient. Fennicæ*, 1927, Series A, 29, No. 18). Samples of flowers examined by these methods were found to contain from 0.4 to 0.6 per cent. of pyrethrin, and stalks from 0.04 to 0.1 per cent. No appreciable differences were found in the amounts of pyrethrin present in open, half open and closed flowers.

**French Colonial Timbers.**—The Association Colonies-Sciences and the Comité National des Bois Coloniaux (44, Rue Blanche, Paris, 9e) have in course of preparation a double series of publications concerned with the timbers occurring in the French Colonial possessions.

The first series comprises scientific monographs each concerned with a separate timber or aspect of the general subject, which will provide a complete study of the timber resources in question from both the scientific and practical points of view. The volumes will be accompanied by plates illustrating the botanical features of the trees and thin sections of the wood. The first volume of this series deals with a method devised jointly by the Association and Comité for the description and classification of timbers with a view to their practical use and comparison with established woods, and a knowledge of principles laid down is essential for useful consultation of the subsequent volumes. The latter appear under the general title of "Nos Bois Coloniaux" and two volumes dealing respectively with Le Bossé (*Guarea cedrata* (A. Chev.) Pellegr.) and Okoumé (*Oucoumea Klaineana* Pierre) are in course of publication, while others dealing with Evino (*Vitex pachyphylla* Baker), Iroko (*Chlorophora excelsa* Benth. et Hook.) and Limbo (*Terminalia superba* Engl. et Diels) are in preparation. The first volume mentioned has already appeared in the *Actes et Comptes-Rendus de l'Association Colonies-Sciences* (1927-28).

Meanwhile, there is being issued a number of special pamphlets intended for lumber men, merchants and users of timber. Five of these very useful publications have been received at the Imperial Institute. They take the unusual but practical form of a folded leaflet (7½ in. × 5½ in.) giving a description of a single timber and enclosing samples of thin veneers illustrating the timber in radial and tangential sections, respectively. Each leaflet with its accompanying samples is contained in a stout paper envelope marked with the name of the timber and evidently intended to be stored on the "card index" system. The leaflets are compiled on a uniform system which provides on the first page well-executed line-drawings of the leaves, flowers, fruits and other

botanical characters of the tree concerned, the fourth page being devoted to a coloured illustration of a characteristic section of the timber. Of the two centre pages one is devoted to a description of the tree and its nomenclature and habitat and an account of the characters of the timber, the other being concerned with industrial and commercial information regarding the mechanical and working qualities of the wood, its uses and present markets. The timbers forming the subject of the five pamphlets received are Bossé (recently identified as *Guarea cedrata* (A. Chev.) Pellegr.) occurring in the Ivory Coast ; Limbo (*Terminalia superba* Engl. and Diels) found in the Cameroons, Gaboon and Moyen-Congo ; Evino (*Vitex pachyphylla* Bak.) found in Gaboon and Moyen-Congo ; Iroko (*Chlorophora excelsa* Benth. et Hook.), found in the Ivory Coast, Cameroons and Gaboon ; and Okoumé (*Aucoumea Klaineana* Pierre) which occurs in Gaboon and Moyen-Congo. Others timbers to be dealt with include Bilinga, *Khaya ivorensis*, *K. Klainei*, Ayous, African Padauk, Ogoué, Bahia, Azobé, Movingui, and Avodiré.

These publications will undoubtedly serve a useful purpose and when complete should form valuable series for both scientific and commercial reference.

## RECENT RESEARCH ON EMPIRE PRODUCTS

A Record of Work conducted by Government  
Technical Departments Overseas

### AGRICULTURE

#### GENERAL

#### Cover Crops

**Federated Malay States.**—The Acting Secretary for Agriculture reports that observations on the growth of different cover plants under dense shade showed that Sarawak Bean (*Dolichos Hosei* Craib) was the most suitable cover plant for cultivation under such conditions. It has now been determined by the authorities at Kew that this plant is synonymous with that known as *Vigna oligosperma* or *Vigna Hosei* Backer, which was introduced into Java and Sumatra at a much later date (see *Malayan Agricultural Journal*, Volume XVI, No. 5, p. 217).

#### SOILS AND MANURES

**Ceylon.**—Mr. A. W. R. Joachim, Agricultural Chemist to the Department of Agriculture, reports that the problems

relating to soils and manures being carried out or completed during the first half of 1928 include the following :

(1) *Leaching and Drainage Trials*.—These are a continuation of the experiments started in November 1926. The results obtained to date appear to indicate that the soils are settling down quite well. The losses of fertilisers from the cropped pots are very much less than from the uncropped pots. Nitrates and lime still continue to be lost in greatest amounts, though to lesser extents than last year. The results were published in the *Tropical Agriculturist* for May 1928.

(2) *Field and Laboratory Studies on the Decomposition of Green and Organic Manures under Aerobic Conditions, from the Standpoint of Nitrification*.—The second series of green manure field experiments have confirmed the results of the first series. A modification of the chemical work involved has been considered necessary. These experiments will be continued for several years. The organic manure field experiment has shown that organic manures, like green manures, give maximum nitrification between the sixth and eighth weeks, and that the direct effects from the nitrogen standpoint of manuring with organics are hardly appreciable after 5 or 6 months. Both series of experiments have to a great extent been hampered by rainfall conditions. The laboratory nitrification experiment with the less-widely used nitrogenous manures, such as urea, ammophos, etc., show that high nitrification percentages are obtained under the conditions of the experiment.

(3) *Field and Laboratory Experiments on the Decomposition of Green Manures under Irrigation (Anærobic) Conditions*.—The field series were undertaken, in co-operation with the Economic Botanist, to determine the "optimum" period of burial of green manures in paddy cultivation. The laboratory experiments were designed to study the chemical changes in nitrogen and humus by the burial of green manures under these conditions. It is too soon to make any statement on the subject, but the results appear to indicate that the exchangeable ammonia contents of green-manured soils are much greater than those of the untreated soils. The advantages of incorporating green manures at the time of puddling the soil, as against the practice of doing so six weeks previous to puddling, seem to be apparent.

(4) *Experiments on the Nitrification of Tea Prunings*.—The field experiment, owing to adverse rainfall conditions, gave no conclusive results. The laboratory experiments



have, however, demonstrated definitely that drying of prunings delays nitrification to a marked extent.

(5) *Nitrogen Losses as a Result of Desiccation*.—An experiment has been started to determine the losses in nitrogen of (a) green manures, (b) tea prunings, as a result of (1) air-drying, (2) leaving the loppings and prunings on the surface of the soil and exposed to the weather conditions till sufficiently dry to enable the leaves to be easily separated from the stems and branches—a practice widely adopted on tea estates. It is too early to make any observations on this experiment.

(6) *Field Studies on Nitrate Variation in Peradeniya Soils*.—A field experiment to determine the amounts of nitrate present at different times in Peradeniya soils subjected to different treatments has been started. The experiment is to be extended over 2 years at least.

(7) *The Manurial Values of the Leaves, Tender Stems and Branches of Dadaps and Gliricidia*.—Analyses have shown that while the nitrogen content of Dadap leaves and tender stems is greater than that of the Gliricidia sample, the percentages of mineral constituents are higher in the latter. In the older stems and branches the reverse is the case.

(8) *The Relation of Soil Moisture to Cover Crops*.—Further determinations of the moisture content of soils under cover crops at the end of a period of drought confirmed the results of previous determinations.

Mr. T. H. Holland, Manager of the Experiment Station, Peradeniya, has reported as follows regarding the work on soil erosion experiments carried out at that Station during the first half-year of 1928. Of the two areas, comprising six plots each, the second year of the experiment terminated in area A on May 31, 1926. In these six plots, which are planted with tea and Gliricidia, after taking a year's initial records from each plot, two plots were planted with *Indigofera endecaphylla*, two with hedges of *Clitoria cajanifolia*, while two were left as controls. In the second year the erosion in all plots was approximately double that of the first year and amounted over the whole area to a loss of 14.1 tons of dry soil per acre against 6.9 tons in the first year. In the absence of any other satisfactory explanation this increase must be ascribed to greater intensity of rainfall as the total rainfall was 7 inches less. The planting of *Indigofera endecaphylla* resulted in a decrease in erosion, compared with the control plot, of 1 per cent. This is expected to increase when the growth of the cover becomes more satisfactory. The planting

of *Clitoria cajanifolia* hedges has resulted in a decrease of 10 per cent. of erosion compared with the control plots.

**Federated Malay States.**—The Acting Secretary for Agriculture reports that the survey referred to in the last half-yearly report (this BULLETIN, 1928, 26, 169) has been continued and has reached the broad area of the Klang Valley. Two hundred and twenty-six soil samples have been taken.

Determinations of a number of "clay" fractions from granite soils have established an average silica content of 45-46 per cent. and a silica/sesquioxides ratio of 1 : 16.

A considerable number of samples of padi soils have been received and are undergoing analysis.

An examination of methods of phosphorus determination has shown that the ordinary molybdate-magnesium pyrophosphate method is extremely unreliable as applied to soils poor in phosphates. Satisfactory results have been obtained with the Denigès method, given preliminary reduction with zinc, and hydrogen-ion regulation with sodium acetate.

**Nigeria.**—Mr. C. Harold Wright, Senior Agricultural Chemist, has reported as follows regarding the work of the Chemical Branch of the Agricultural Department for the first half-year, 1928.

Work on the electrical conductivities of 1 to 5 soil extracts as an index of soil fertility (see *Journal of Agricultural Science*, 1928, 18, 186) has been continued, and analyses of the soil extracts have also been made. It has been found that the specific conductivities of soils taken at regular intervals from the same plots decrease after rain and increase again during the succeeding dry weather; this increase is greater on uncropped than on cropped soils owing to the removal of electrolytes by the growing crop. It has also been found that the calcium, potassium and nitrates in the 1 to 5 soil extracts prepared from the same soil samples vary in the same way; and that the quantities of these constituents are generally in the same order of magnitude as the specific conductivities in the case of soils taken on any one day.

Mr. Hartley states that the work mentioned in the 1927-28 report is at present suspended, but the necessary routine determinations are being continued until Mr. Diamond returns from leave.

Experiments have been started to determine how far frequent cultivation improves soil conditions for a growing crop.

During the dry season a plot of late maize was divided into strips which were alternately hoed once a week and left entirely uncultivated except for periodical cutting down of high weeds. The effect of the mulching was very marked. For a period of about three months both the moisture and nitrate contents of the cultivated plots were appreciably above those of the uncultivated. These differences were reflected in the crops, which failed entirely on the uncultivated plots but gave small yields on the others.

A similar experiment now in progress promises to give similar results with respect to nitrate content, although frequent rain is hiding any difference there may be in the retention of moisture. The crop is not yet harvested.

**Sierra Leone.**—The following résumé of work on soils and manures conducted by the Division of Research during the first half of 1928 has been furnished by the Acting Commissioner of Land and Forests.

The soils of Sierra Leone may be roughly classified as red and yellow laterites and lateritic gravels, containing a large but varying proportion of "stones"; red sandy soils, chiefly limited to valleys; brown lateritic sands and sandy loams; black swamp and alluvial soils of varying texture; and black grit containing a high content of small stones.

The chief characteristics of these soils may be summarised as follows:

(a) Practically all soils are "light" and easily penetrable by water except some swamp and few valley soils.

(b) All soils are more or less acid (pH 4-6).

(c) Practically all soils are either laterites or lateritic (silica/alumina ratio of clay fraction less than 2).

(d) All soils have a definite lime requirement (generally from 0.2-0.3 per cent.).

(e) The organic matter varies usually from 2.0-4.0 per cent. except in the case of some swamp soils where it is appreciably higher.

(f) The potash content is low in all except the black grit (0.02-0.13 per cent.  $K_2O$  soluble in strong HCl).

(g) The phosphorus content varies from 0.07 to 0.19 per cent.  $P_2O_5$  soluble in strong HCl.

(h) The nitrogen content varies in proportion to the organic matter and lies between 0.05-0.2 per cent.

An attempt has lately been made to organise the fishing industry of Sierra Leone, by improving the methods of catching the fish and adopting modern methods in

salting and curing. In addition experiments have been made in extracting oil from the fish and utilising the residue as a fish manure. An analysis of this manure yielded the following results :—

	Per cent.
Moisture . . . . .	11.02
Nitrogen . . . . .	7.9
Phosphoric acid ( $P_2O_5$ ) . . . . .	11.89
Potash ( $K_2O$ ) . . . . .	0.5

## BEVERAGES

### Cocoa

**Ceylon.**—Mr. N. K. Jardine, Inspector for Plant Pests and Diseases (Central) reports that *Helopeltis antonii* Sing., the bark borer *Arbela quadrinotata* Wlk. and the spotted locust *Aularches miliaris* are the most serious insect pests of cocoa in Central Ceylon, particularly in village gardens. The last, which can be a very serious defoliator, is comparatively simple to check by a careful location of egg-laying grounds. According to Dr. J. C. Hutson, the results of experiments with soap and water solution against the immature stages of the spotted locust, which were reported on during the early part of this year, have confirmed the satisfactory results previously obtained (see *Annual Report, Division of Agriculture, 1927*).

Certain areas under village cultivation in Galboda Korale and Paranakura Korale of Kegalle District have been practically abandoned owing to the depredation of the squirrel (*Funambulus palmarum favonicus*).

**Gold Coast.**—According to the Acting Director of Agriculture the determination of the yield of individual cocoa trees has been continued and also the trials of yield from definite areas at all Experiment Stations. The voluntary system of examination of cocoa at the ports is still in existence and various investigations arising out of the work have been carried out. These investigations are chiefly concerned with the various defects which have been noted, and comprise (1) the character of the moulds which form within the bean and their classification; (2) the standard of hygroscopic moisture and its relation to mould incidence and its variation with the humidity of air; (3) the seasonal variations of the various defects as shown by the varying percentages contained in the samples at different times in the year; and (4) a mathematical definition of "plumpness" in cocoa beans has been attempted. All the defects noted, together with the

causal factors, remedies and characteristics, will be dealt with in an illustrated leaflet to be published shortly.

Investigations into the effect of the sea passage on cocoa and into the effect of storage, together with the life-histories of the insects attacking stored cocoa beans, have also been made.

The work on pod-disease and on *Sahlbergella* recorded in *Bulletins* 6 and 3, respectively, of the Department of Agriculture has been continued further.

A map showing the distribution of cocoa throughout the country, based on railway shipments, export figures and the personal experience of officers, was prepared and will form the basis for a systematic survey of such areas as presented difficulties during its preparation. The complete survey will gradually follow on from this commencement.

### *Coffee*

**Uganda.**—The Entomologist, Department of Agriculture, has recorded complete control of the coffee bug, *Antestia lineaticollis* Stal., by the use of the sodium arsenite and jaggery mixture used in Tanganyika. This is prepared by using  $\frac{3}{4}$  oz. of sodium arsenite, 2 lb. of jaggery and 4 galls. of water. It is essential that the mixture be applied as a fine misty spray, to prevent large drops forming on the leaves.

### *Tea*

**Ceylon.**—Mr. T. H. Holland, Manager of the Experiment Station, Peradeniya, states that the results obtained from tea plots planted with a creeping cover of *Indigofera endecaphylla* were incorporated in an article published in the *Tropical Agriculturist*, and a paper on this subject was also read before the Third Agricultural Conference held at Peradeniya in May 1928. Briefly, the planting of the cover crop appears up to date to have had no marked effect on the yield of tea. Soil analyses reveal a satisfactory increase in organic matter but no general increase in the total nitrogen content.

Seventy-eight plots of forty bushes each were laid out for a manurial experiment at the end of 1925. After taking yields without manuring over an initial period of two years between prunings, the manures were first applied to these plots in March 1928. The death of a number of bushes after pruning has emphasised the difficulty of elaborating a satisfactory field technique for tea experiments.

A small nursery experiment with Pabco mulch paper

has revealed no sufficient advantage in the use of this substance in a tea nursery to compensate for its cost.

Dr. J. C. Hutson, Entomologist to the Department of Agriculture, reports that during the first half of 1928, the investigation of tea termites (*Calotermes* spp.) was continued by the Assistant Entomologist and the 3rd Assistant in Entomology. In the breeding experiments the original series of tubes has now been carried on without a break for more than a year and a half, and a large number of new breeding tubes has been started during the early part of this year. The Assistant Entomologist states that "Many facts of interest and importance have come to light and further developments are anticipated which, it is hoped, may throw an entirely new light on the very complex and little understood phenomena of polymorphism among these insects."

As indicated in the Annual Report of the Entomological Division for 1927, there is no practicable method, so far as is known at present, of treating individual old tea bushes with an insecticide so as to be certain of killing every single member of a long-established colony of *Calotermes*. The Assistant Entomologist is of opinion that the destruction of *C. miliaris* within infested bushes must be followed by the filling of the large cavities formed in the main stem in order to prevent the possible subsequent re-invasion by the winged forms. With this object in view, preliminary experiments are being made with various plastic fillings. The problem of protecting the larger pruning cuts and "wood-rot" surfaces with antiseptic and waterproof dressings is also receiving further attention.

According to Mr. N. K. Jardine, Inspector for Plant Pests and Diseases (Central), 89 Estates have been inspected chiefly in reference to tea tortrix (*Homona coffearia* Nietn.), which became a declared pest under the Plant Protection Ordinance in November 1927. The regulations requiring the collection and destruction of egg-masses are in operation throughout the tea-growing area. By the continual daily collection of the egg-masses, there is evidence that the overlapping of broods is being eliminated in the areas where the pest is serious: this is an important factor in that the occurrence of the pest may become seasonal and consequently control measures more effective.

The regulations requiring a permit for the removal of tea plants have been effective in checking the dissemination of shot-hole borer (*Xyleborus fornicatus* Eich.) into areas free from the pest.

Mr. W. R. C. Paul, Acting Plant Pest Inspector (Southern), reports that shot-hole borer (*Xyleborus fornicatus*) has attracted some attention in the Southern Division. It was reported to be responsible for severe loss to tea in the Deniyaya area. The attack may, however, be largely attributed as a result of the lowered vitality of the bushes brought about by drought and high winds. The matter is under investigation. *Helopeltis* attack on tea, especially the lower jâts, is common in Deniyaya. Tea tortrix (*Homona coffearia*), is only found to a slight extent and cannot be considered as a pest in the Division. Bagworms of various species on tea have been severe in the Galle district. The attacks are, however, localised and are associated with the presence of the shade tree *Albizia molucanna* on which they occur noticeably. Other pests of minor importance on tea in the Southern Division are *Stauropus alternus*, the lobster caterpillar, and *Adoxophyes privatalana*—new records for the division—and *Zeuzera coffeæ*, red or coffee borer.

Red rust (*Cephaleuros* sp.) has been common on neglected tea in the Southern Division. A recent attack of *Macrophoma theicola*, branch canker on tea, was noted on an estate in Deniyaya. The case was interesting in that prolific callus formation at frequent intervals along the affected stems took place. Die-back (*Diplodia* sp.) has occurred very noticeably on many estates in the Division. This is probably a result of the recent drought, which retarded the growth of many plants.

**Nyasaland.**—Mr. H. J. W. Hornby, Agricultural Chemist, reports that amongst green manures, especially for tea, sunn hemp, bush velvet beans, and numerous varieties of soy-bean have been tried. Of the varieties of soy-bean, O-too-tan and Biloxi gave the best results as the following table shows.

—	Yield lb per acre of seed	Time in reaching maturity in days.	
		Nyasaland	America
<i>Soy-beans</i>			
O-too-tan . . .	1,010	106	—
Biloxi . . . .	825	109	160
Tokio . . . .	591	101	—
Goshen Prolific . . .	310	99	145
Tarheel . . . .	237	78	140
Hayto . . . .	226	92	135
Laredo . . . .	99	114	145
Chuquita . . . .	177	111	135

O-too-tan should prove useful as a green manure crop at higher and upper middle elevations, either alone or

interplanted with other crops. It shows promise amongst tea in Mlanje.

Biloxi shows distinct promise as a green manure and yields a fair crop of palatable beans which should be useful as a subsidiary food crop.

As regard the shattering of soy-beans in the field, this is not considered a disadvantage if harvesting is done at the correct time (see *Journ. Amer. Soc. Agron.*, Vol. 17, p. 157). When it is considered that the feeding value of 1 lb. of soy-bean flour is equal to 2 lb. of meat and  $\frac{1}{4}$  lb. of wheat flour, the growing of this crop should become more popular at higher elevations. A yield of 600 lb. becomes of increasing moment (see "China: Land of Famine," *Amer. Geog. Soc. No. 6, Spec. Pub.*).

Other leguminous plants which may be of use for green manuring tea and coffee land (at Zomba and other stations) are the following, but attention will have to be paid to inoculation of the soil with the appropriate bacteria.

Bunch velvet beans ( <i>Stizolobium deer- ingianum</i> )	Good in every respect.
Bush lima beans ( <i>Phaseolus lunatus</i> )	Good growth especially late.
Kentucky wonder beans ( <i>P. communis</i> )	Fair; for short late crop at higher elevations.
Madagascar bean ( <i>P. helvolus</i> )	Climber; fair growth, slow starter.
Fish bean "Ntutu" ( <i>Tephrosia Vogelii</i> )	Fair only.
<i>Tephrosia candida</i>	Fair; useful as wind-break.
Sunn hemp ( <i>Crotalaria juncea</i> )	Very good.
<i>Crotalaria striata</i>	Good.
"Nandolo" ( <i>Cajanus indicus</i> )	Fair; good on poor soils.
<i>Cassia hirsuta</i>	Poor at higher elevations.
<i>Indigofera arrecta</i> and <i>I. endecaphylla</i>	Growth fair. Suitable in mixed manuring.
Tifton Burr Clover ( <i>Medicago hispida</i> )	Fair late growth at higher eleva- tions.
Lucerne ( <i>M. sativa</i> )	Fair late growth at higher eleva- tions.
Ground-nuts, "Ntedza" ( <i>Arachis hypo- goea</i> )	Fair at all elevations on sandy loams.
Mung bean, "Mpoza" ( <i>Phaseolus</i> sp.)	Attacked badly at lower elevations with leaf-eating insects.
Japan clover ( <i>Lespedeza</i> sp.)	Fair. Needs further trial.
<i>Vigna oligosperma</i>	Poor at higher elevations.

Amongst other legumes tried may be mentioned sainfoin, crimson clover, trefoils, vetches, subterranean clover, and Bokhara clover, which seem never to have shown any promise in Nyasaland.

*Sesbania* spp. have shown no promise. Lupines grew very well for a short period but proved to be very susceptible to disease and nematode attack. Climbing varieties of cowpeas (*Vigna sinensis*) and velvet beans have been as usual very successful for certain rotations. Late planted mung bean or green gram suffered from white rust or field mildew.



## CEREALS

*Rice*

**Ceylon.**—Mr. L. Lord, Economic Botanist to the Department of Agriculture, reports that the following work was carried out by his Division during the first half-year of 1928 :

(1) *Pure-line Selections.*—The main lines have been maintained at Peradeniya and of the selections which have already shown promise at the different Paddy Stations sufficient pure seed has been grown to supply the Stations. The results of preliminary trials of new selections at Paddy Stations have been worked out and the necessary discards made. Field trials of main lines have been carried out at all Paddy Stations by Divisional Officers (see pp. 443-447). At Anuradhapura, owing to shortage of irrigation water, work was confined to making selections of Hill paddy (Elwi).

(2) *Trial of Foreign Rices.*—A trial of four large-grained stiff-strawed Burma paddies was harvested during the period under review and all varieties show promise. The trials will be repeated. A number of Californian selections have been sown but these do not appear to be promising under Peradeniya conditions.

(3) *Experimentation Technique.*—A further experiment was harvested during the half-year and the results incorporated in a paper to be published in the *Annals of the Royal Botanic Gardens, Peradeniya*, the Botanical Section of the *Ceylon Journal of Science*. This latter investigation has shown that the best way of dealing with yields of rod-row plots when a number of plants have been destroyed is to use an area basis and not a plant basis.

(4) *Manuring of Rice.*—Two series of permanent manurial experiments have been prepared and will be laid down during the *Maha* season of 1928-29 at Peradeniya and Anuradhapura. A temporary manurial experiment was laid down at Peradeniya during the present *Yala* season. The crop will be harvested in August. The effect of a soluble phosphatic fertiliser in promoting early vigorous growth both above as well as below ground is very evident.

(5) *A Pest of Stored Paddy.*—In most districts of Ceylon, rice stored in the husk is found to be more or less badly infested with paddy moth (*Sitotroga cerealella*). An experiment was started to determine the effect of attack of paddy moth on the germination of the seed. Preliminary results show that under Anuradhapura conditions the germination of seed stored in gunny bags exposed

to moth attack for four months is 15 per cent. less than similar seed stored in insect-proof bins. The experiment is being repeated at Peradeniya. At Peradeniya, however, a new paddy seed store has been completed in which seed can be fumigated with carbon bisulphide at reasonable cost and so be protected from serious moth or weevil attack.

(6) *Measurements of Rice Grains*.—During the period under review a method of measuring rice grains was statistically examined and used for measuring the more popular pure-line selections. A short paper has been prepared and submitted for publication. The grain measurements of the commonly-grown Ceylon rices are very similar to those of the widely-grown *Ngasein* rice of Burma.

(7) *Rice Outturns*.—Certain village paddies and pure-line selections were husked according to the village methods, both raw and parboiled, for analysis by the Agricultural Chemist who has already published in the *Tropical Agriculturist* the results of his analyses (see below). An account of rice outturns has also been published in the same journal. Parboiling reduced breakage to a large extent and it was found there was less breakage with pure-line selections than with village varieties.

Mr. A. W. R. Joachim, Agricultural Chemist to the Department of Agriculture, reports that the following investigations were completed during the first half-year of 1928.

(1) *The Chemical Composition of Some Ceylon Paddies and Paddy Products*.—A study of the chemical composition of some Ceylon paddies, rices and milling products, and of the changes on keeping par-boiled rice was undertaken. The results are detailed in a paper in the *Tropical Agriculturist*, April 1928.

(2) *The Effects of Refuse Water from Coconut Fibre Mills on the Yield of Paddy*.—A pot experiment, designed to ascertain the effects on the germination and yield of paddy of a 10 per cent. dilution of the refuse water from coconut fibre mills, showed that while the germination of the seedlings was not affected, the yield of both paddy and straw were affected adversely.

(3) *Paddy Green Manuring Studies*.—These have already been referred to under Soils and Manures (see p. 433).

The work on rice conducted in the various divisions and districts of Ceylon has been reported on by the respective Agricultural Officers and Inspectors as follows :

*Central Division*.—Pure-line paddy trials were con-

ducted during the last *Maha* season with the following results :

	<i>Lb.</i>	<i>Bushels.</i>	<i>Per cent.</i>	Percentage increase or decrease.
<b>Kotmale :</b>				
1. Local Mavi . . . . .	1,287	29	100·0	—
2. P.9 . . . . .	2,060	46½	160·0	+ 60·0
3. P.10. . . . .	1,887	42½	146·6	+ 46·6
4. W.15 . . . . .	1,862	42½	144·6	+ 44·6
5. B.11. . . . .	1,212	27½	94·6	— 5·9
6. I.17 . . . . .	1,150	24	89·3	— 10·3
<b>Kegalle : (Mattamagoda) :</b>				
1. Local Mavi . . . . .	1,490	34	100·0	—
2. G.3 . . . . .	1,586	33½	106·4	+ 6·4
3. I.17 . . . . .	1,171	26½	78·6	— 21·4
4. W.15 . . . . .	1,129	25½	75·8	— 24·2
5. P.9 . . . . .	1,106	25	74·2	— 25·8
6. B.11. . . . .	944	21½	63·3	— 36·7
<b>Katugastota :</b>				
1. Local Hatuel . . . . .	1,970	44½	100·0	—
2. B.12. . . . .	2,275	57½	115·4	+ 15·4
3. B.12 K . . . . .	2,030	46½	103·0	+ 3·0
4. I.17 . . . . .	1,964	44½	99·6	— 0·4
5. B.12 A . . . . .	1,918	43½	97·3	— 2·7
6. B.11 A . . . . .	1,537	35	78·0	— 22·0
7 P.9 . . . . .	1,150	26	58·3	— 41·7

A chain of stations of pure-line paddy was also established between Kotmale and Matale. These trials were in the hands of the Goiyas and the results obtained confirmed the trials made at the various Experiment Stations. Arrangements are now being made for the growing and extension of these varieties.

*Southern Division.*—Continued progress has been made at the seven paddy seed stations situated throughout the Division. Selection work, under the direction of the Economic Botanist, is being carried out at each station with a view to selecting a high-yielding variety of paddy suitable for distribution locally. Good results have already been obtained at the Tissamaharama (Hambantota District) Station where a suitable variety (Mb 27) of Murungan last season gave an increased yield of 36 per cent. more than the local (control) Sinnanyam. Other stations also are showing signs of success.

*Northern Division.*—Pure-line paddies are being multiplied in the stations at Paranthan, Vavuniya, Uyilankulam, Kanniyai, Tamblegam and Anuradhapura. These paddies are becoming increasingly popular in this Division and are gradually beginning to replace the strains originally grown by the cultivators. The varieties which are popular are Mb-27 and Mb-14. Among the new selections 2442 Palasithari Nos. 1 and 17, and among the main lines Ib-16 have given encouraging results.

*North-western Division.*—The *Maha* crop at Kuru-negala was harvested between January 16 and 31. The crop in the seed multiplication plots was gathered and thrashed between February 1 and 4, and the following yields were obtained :

	Quantity sown.	Yield.
P.5 Sudumavi . . . . .	$\frac{1}{2}$ bushel	15 $\frac{1}{2}$ bushels
W.15 Mavi . . . . .	"	9 $\frac{1}{2}$ "
a.8 Podivi . . . . .	"	17 $\frac{1}{2}$ "
g.18 Molagusamba . . . . .	"	9 $\frac{1}{2}$ "
k.16 Surasamba . . . . .	"	7 "
l.10 Puluksamba . . . . .	"	10 "

The following yields of grain were obtained from the replicated plots :

	Total yield. Cut measure.	Average yield per plot. Cut measure.	Ratio Control = 100.
Control Puluksamba . . . . .	61 $\frac{1}{2}$	10.25	100.0
a.8 Podivi . . . . .	62	10.39	101.4
a.12 Podivi . . . . .	64 $\frac{1}{2}$	10.75	104.8
g.18 Molagusamba . . . . .	61 $\frac{1}{2}$	10.25	100.0
G.3 Mahamavi . . . . .	65	10.83	105.6
l.10 Puluksamba . . . . .	64 $\frac{1}{2}$	10.75	104.8
l.17 Mavi . . . . .	87 $\frac{1}{2}$	14.60	142.4
k.16 Surasamba . . . . .	57 $\frac{1}{2}$	9.58	93.4
P.5 Sudumavi . . . . .	73 $\frac{1}{2}$	12.25	119.5
P.9 Sudumavi . . . . .	65 $\frac{1}{2}$	10.97	107.1
W.11 Mavi . . . . .	66 $\frac{1}{2}$	11.12	108.5
W.15 Mavi . . . . .	68 $\frac{1}{2}$	11.39	111.7

The following yields of straw were obtained from the replicated plots :

	Total yield. lb.	Average yield lb.	Ratio Control = 100.
Control Puluksamba . . . . .	115 $\frac{1}{2}$	19.2	100.0
a.8 Podivi . . . . .	122 $\frac{1}{2}$	20.4	106.0
a.12 Podivi . . . . .	125	20.8	108.2
g.18 Molagusamba . . . . .	114 $\frac{1}{2}$	19.0	99.1
G.3 Mahamavi . . . . .	140	13.3	121.2
l.10 Puluksamba . . . . .	132 $\frac{1}{2}$	22.0	114.7
l.17 Mavi . . . . .	173	28.8	149.7
k.16 Surasamba . . . . .	126	21.0	109.0
P.5 Sudumavi . . . . .	138	23.0	119.4
P.9 Sudumavi . . . . .	123	20.5	106.4
W.11 Mavi . . . . .	135	22.5	116.8
W.15 Mavi . . . . .	130	21.6	112.5

During the ripening period paddy plants in all the plots had lodged ; otherwise a higher yield in grain could have been obtained. It was noticed that the grains of a.8 shed very early, whereas the grains of W.11 were with difficulty removed from their earheads during the process of threshing.

The following paddies were sown on May 8 in the Kurunegala paddy plots :

Kalu-heenati	.	.	.	4	lahas
Sudu-heenati	.	.	.	4	"
Mada-el (control)	.	.	.	3½	"
Sudu-kottiyaran	.	.	.	3½	"

All the plots were weeded between June 11 and 21. The other plots are being dug and ploughed in preparation for the *Maha* cultivation. Nine bushels of *Yala* and six and a half bushels of *Maha* seed paddy were sold to Puncha and Beni of Henemulla, Bandiya of Kuliypitiya, W. R. Fernando and Kapuhoratala of Ihala-Ketha. Due to the failure of the south-west monsoon the *Yala* crop in the district has failed.

The *Maha* crop at Madampe was harvested in February. Owing to the rains in March threshing was delayed. The following yields were obtained from the seed multiplication plots :

		Quantity sown.	Yield.
a.8	Podivi	4 bushels	16 bushels
G.1	Mahamavi	1 "	3 "
P.1	Sudumavi	1 "	4 "
P.5	Sudumavi	1½ "	7 "
P.9	Sudumavi	1 "	3 "
W.15	Mavi	½ "	1½ "
	Salt water paddy	½ "	failed

On account of the failure of the south-west monsoon, no work has been done in the Madampe trial plots.

The following yields have been obtained from the Madampe replicated plots :

		Total yield. Cut measure.	Average yield per plot. Cut measure.	Ratio Control = 100.
Control	Podivi	15½	2.62	100
a.8	Podivi	23	3.83	146
a.12	Podivi	21	3.50	133
G.1	Mahamavi	23½	3.91	149
i.10	Puluksamba	20½	3.45	131
I.17	Mavi	17½	2.91	111
P.5	Sudumavi	23½	3.87	147
P.9	Sudumavi	16½	2.70	103
W.11	Mavi	21½	3.54	135
W.15	Mavi	23½	3.87	147

*Batticaloa District.*—Experiments with paddy were continued at Illupaiadichenai and Chengapada.

In the manurial trials an increased yield of 72 marakals or 18 bushels per acre was obtained over the unmanured, the manured portion giving a yield of 179 marakals or 42½ bushels, while the unmanured gave 99.5 marakals or 24.7 bushels.

An experiment to test the effect of weeding showed that the weeded portion gave an increased yield of 54 marakals over the unweeded portion (i.e.  $13\frac{1}{2}$  bushels per acre), the former giving 153 marakals or  $38\frac{1}{2}$  bushels per acre, while the latter gave 99 marakals or  $24\frac{1}{2}$  bushels. The cost of weeding was Rs.6/- per acre.

Paddy selected on the 5 per cent. salt solution test gave an increased yield of 99 marakals or  $24\frac{1}{2}$  bushels per acre. The selected and manured portion gave 179 marakals or  $44\frac{1}{2}$  bushels per acre, while the unselected manured plot gave a yield of 161 marakals or  $40\frac{1}{2}$  bushels.

*Veyangoda District.*—Experiments with pure-line paddies were conducted in 1927 at the Belummahara Paddy Station and the results of the experiments were obtained in March 1928.

The experiments were based on the selection of a good strain of paddy which gives the highest yield under local conditions. The following are the varieties of pure-line paddy used in the experiment, viz. : G.3, K.7, b.13, l.17, A.12, W.15, i.10, E.24, c.14 and local Sudu-Wi.

In conducting the experiment the plots were laid out according to the method known as the Randomisation System. In laying out the plots each variety of paddy was replicated ten times in plots of  $1/200$  acre. At harvest the earheads of the hundred plots were reaped separately. Later, they were thrashed and weighed separately to compare the results of each variety with the local paddy. The results showed that the following varieties proved to be superior in order of importance to the local variety, viz. : (1) b.13, (2) k.7 and (3) G.3. Of these b.13 was recommended as the variety best suited for the district and about 67 bushels of this variety which were produced at the Paddy Station were distributed as seed paddy.

*Pests and Diseases.*—According to Mr. N. K. Jardine, Inspector for Plant Pests and Diseases (Central), the swarming caterpillar (*Spodoptera mauritia* Boisa) the paddy fly (*Leptocorisa varicornis* F.), and the paddy stem borer (*Schoenobius incertellus* Wlk.) are the most prevalent of the paddy insect pests in the Central Division. The Ceylon mole rat (*Gunomys gracilis*) is a serious pest of paddy, whilst the field mouse (*Leggada booduga*) is capable of considerable damage to paddy in the foot hills of the Division.

Mr. W. R. C. Paul, Acting Plant Pest Inspector (Southern), reports that three new records on paddy were noted for the Southern Division, viz. : *Pachydiplosis oryzae*, *Tettigoniella spectra*, and *Menida histrio*. The

gall fly, *Pachydiplosis*, has been very abundant in Kalutara District, several fields, especially those less fertile, being attacked. The Jassid *Tettigoniella* was found on paddy leaves at Horana heavily parasitised by an unidentified fungus. *Menida histrio* occurred on the ears of paddy in small numbers early in the year.

*Podops scutellata*, *Parnara mathias*, and *Cnaphalocrocis medinalis* were recorded as minor pests of paddy from the Kalutara, Matara and Galle districts respectively.

An outbreak of *Spodoptera mauritia* on paddy was noted from the Matara district. Two blocks were seriously attacked but the pest was finally checked by crows and other birds which devoured many of the caterpillars.

The paddy fly (*Leptocorisa varicornis*) was found on the Paddy Seed Station, Bandaragama, specially attacking one variety of paddy which was sown a week late as compared with the other varieties grown alongside. Whether this is due to any particular susceptibility of this variety or not is not definitely known. The fly is, however, common throughout the Division.

With regard to diseases, Mr. Paul reports that *Piricularia oryzae* and *Helminthosporium* sp. were observed on paddy in the Kalutara district, the latter being a new record for the division.

In the North-Western Division, according to Mr. C. N. E. J. de Mel, Plant Pest Inspector for that division, *Spodoptera mauritia* and *Leptocorisa varicornis* also cause considerable damage, although the attacks are few compared with the extent of paddy areas. *Schænobius incertellus* causes occasional damage in this Division, whilst *Parnara mathias*, a leaf-eating caterpillar, is a minor pest. The blast disease, *Piricularia oryzae*, is negligible in this area.

#### FODDERS

**Ceylon.**—Mr. T. H. Holland, Manager of the Experiment Station, Peradeniya, reports that of the grasses at present under trial at the Station, *Paspalum Commersonii* has proved unsatisfactory. The plot will be replanted with Guatemala grass, *Tripsacum laxum*, a grass from the Philippines which shows considerable promise.

The cultivation of Napier grass, *Pennisetum purpureum*, is spreading rapidly, particularly on up-country estates.

Trials with various fodder grasses, etc., have been carried out on patanas of the Hakgala Botanic Gardens in order to ascertain if any useful grasses could be found to

replace the hard patana grasses of poor feeding value. So far, however, according to Mr. F. A. Stockdale, Director of Agriculture, the results have not been encouraging. Some grasses are growing, but economically their growth has not been satisfactory. The following report on the trials has been made by Mr. K. J. A. Sylva, Acting Curator of the Gardens.

*Paspalum dilatatum* (Golden Crown Grass).—This grass is doing well and is well adapted to the Hill Districts of Ceylon. This, in addition to affording excellent fodder for milch cows, has proved useful in binding banks and for the prevention of soil erosion to steep lands. The plant stands grazing or cutting well.

*Paspalum* sp.—This is found growing in certain parts of the garden and also in Nuwara Eliya and is supposed to be an introduced species. The grass is doing fairly well on the patanas but prefers a low-lying ground or ravine. So far it has not produced flowers, thus rendering it difficult for identification. Owing to the deep rooting habit of the plant it stands the drought well. Cattle are not fond of it but eat it occasionally.

*Paspalum Larranagai*.—This grass is growing vigorously and appears to be much hardier than *Paspalum dilatatum*. It stands the drought fairly well and yields a fairly good fodder for grazing or cutting.

*Axonopus compressus* (Carpet Grass).—This is growing well. Cattle appreciate it. Owing to the slow and tufty nature of its growth it makes a good lawn grass or for binding earth banks.

*Paspalum Commersonii*.—This is doing fairly well and appears to be well adapted to local conditions. The cattle relish it as much as *Paspalum dilatatum*.

*Napier Grass*.—Doing fairly well and appears to be getting acclimatised at Hakgala. Cattle eat it.

Seeds of the following fodders were imported from Melbourne.

*Rhodes Grass*.—Seeds germinated well, but the subsequent frost killed a large percentage of seedlings. The remaining plants are doing well and appear to have become established.

*Native Trefoil* (Burr Clover).—Seeds germinated well, but the frost and the drought experienced at the early stage of growth killed all.

*Japanese Millet*.—Germinated well but killed by frost and drought.

*Cluster Clover*.—The seeds are just germinating.

*Melilot, King Island*.—Germinated well but killed by frost.



*Paspalum dilatatum*.—Although the progress of the growth of the seedlings was considerably retarded by the effects of frost the plants are growing well.

*Broom Corn*.—Germinated well. A good percentage of seedlings was killed by frost. Those remaining appear to be going off.

*Sudan Grass* (Genuine Garawi).—Germinated well. The whole plot of seedlings was entirely killed by frost.

In the Central Division Guinea and *Paspalum* grasses are being experimented with on some village pasture lands in the Kegalle District, and results are promising. Guinea grass and *Paspalum Commersonii* planted on the Kegalle Experiment Station have been established without much difficulty.

Trials have been made with a number of fodder grasses at the Bata-ata Cotton Rotation Station in the Southern Division to test their suitability for growth as cattle fodder in the dry zone. As regards growth two grasses were outstanding, namely, *Pennisetum cenchroides* and *Paspalum Commersonii*; the former has been found suitable for feeding and is liked by the Station bulls, whilst the latter has to be used with care as it has a purging effect on the animals. Next in merit were Guinea Grass (*Panicum maximum*) varieties A and B (broad and narrow leaved), closely followed by Merker's grass (*Pennisetum Merkerii*) and Napier grass (*Pennisetum purpureum*). Guatemala grass (*Tripsacum laxum*) is proving slow to establish itself, but trials with it are being continued. Buffalo grass, Efwatakala grass (*Melinis minutiflora*) and *Paspalum larranagai* have been discarded as unsuitable for local conditions, being most difficult to establish.

Napier grass and Guinea grass are grown chiefly in the Anuradhapura, Jaffna and Mannar Stations, Northern Division. Efwatakala grass is tried at Anuradhapura only. All these varieties are withstanding drought remarkably well. Periyamanjal cholam grown in the Experiment Station, Jaffna, has been harvested and fed to cattle. *Leucæna glauca* promises to be a suitable crop for the dry lands of this district. The unripe pods, seeds, as well as the leaves, are eagerly eaten by the cattle.

## FRUITS

### *Bananas*

**Ceylon**.—Mr. N. K. Jardine, Inspector for Plant Pests and Diseases (Central), reports that bunchy top disease,

the aphid *Pentalonia nigronervosa*, the stem-borer weevil (*Odoiporus longicollis* Oliv.), and the root-boring weevil (*Cosmopolites sordidis* Germ.) are the most serious of the plantain pests in the Central Division. They are found in all plantain areas throughout the Division.

According to the Divisional Agricultural Officer in the Central Division trials with various types of plantains are being made at Kegalle with a view of testing their immunity from bunchy top disease. Varieties are being imported from Burma and Malaya, and local varieties are now being collected from all over Ceylon. It is of importance that there is one variety which is standing up against this disease at the present time, in spite of the fact that varieties on each side of it are very badly infected. This variety was imported from Malaya and is known as Embon. Bunchy top generally can be considered to be on the decrease at the present moment and advice is being given to the cultivators on the importance of selecting suckers from uninfected areas.

Mr. W. R. C. Paul, Acting Plant Pest Inspector (Southern), reports that bunchy top has been found to be on the decrease this year in the Southern Division, especially in the Kalutara district. The disease is more or less absent in the dry zone and at Tissa no bunchy top plants were found though their absence cannot yet be definitely stated. Three new diseases of plantains tentatively identified were reported from Tissa : (1) Panama disease, (2) Leaf spot and yellowing disease associated with a *Colletotrichum* and an atypical *Cercospora*, (3) Heart-rot and rot of the growing leaf.

According to Dr. J. C. Hutson, Entomologist to the Department of Agriculture, the connection between the plantain aphid (*Pentalonia nigronervosa*) and bunchy top in Ceylon has not been definitely proved so far, and a further series of experiments is to be started as soon as material known to be free from bunchy top can be obtained for trial.

### *Citrus*

**Montserrat.**—Mr. C. A. Gomez, Curator of the Experiment Station, reports that budding of limes and grapefruit on sour orange stock was successfully started during the first half of 1928 and nurseries were extended for expediting this method of propagation. The greatest effort is being made to resuscitate this industry.

## ROOT CROPS

## Yams

**Nigeria.**—Mr. O. B. Lean, Entomologist, Department of Agriculture, reports that the study of the Dynastic beetle, *Heteroligus claudius* Klüg, which has proved a serious pest of yams in the Benue Province, has been continued throughout the first half of 1928.

Mr. Iwenjora, the assistant who had charge of the breeding experiments while Mr. Lean was on leave, was successful in bringing a number of larvæ through to the adult stage. The larva was found to thrive in damp soil and to feed on yam tubers. All larvæ kept in cages without yam failed to mature.

Adults emerged from the beginning of March until the end of May, and in the field freshly emerged adults have been found at the end of June.

Some of the reared adults have been kept without yams and are still alive.

The small type of *H. claudius* found in the field towards the end of the yam season and also found in bushland during the dry season has shown different breeding habits from the larger type. Some of the small type oviposited in May and June.

A trial of possible control measures against *H. claudius* has been initiated over about 50 square miles in Tombo W. in the Benue Province. It seemed that the scattering of the previous year's yam heaps, when the gero was sown, might kill off larvæ and pupæ in the soil. All farmers in the area were also instructed to plant all yams early to enable the plants to make good growth.

Under the supervision of the Superintendent of Agriculture, Yandev, every farmer in the area scattered his heaps. It was intended that all yams should have been planted by March 1, but it was found very necessary to extend the period until March 28, as many farmers had not prepared enough land in time.

There are about 100 villages growing yams in the district. Most of these have now been examined and a beetle index has been taken on many. On no farm has the beetle been found to be numerous and a good crop is probable. In the centre of the area there are an average of about 49 beetles per 1,000 heaps, whereas last year they were present at the rate of 1-5 beetles per heap. They are a little more abundant towards the northern boundary, but the maximum number of beetles per 1,000 heaps (what Mr. Lean terms the Beetle Index) is 156 only.

As yet no very great number of farms outside the area

have been examined, but there is evidence of a very general decrease in numbers of beetles. Two farms just outside the northern boundary both gave indices of 267.

As yet it is impossible to say whether the control methods have been a cause of the improvement.

In several other districts where the attack was serious last year the beetle is very scarce now. Two years ago the centre of the infestation lay on the eastern side of the River Katsina in Ugondo and Tombo East. Last year it had moved across the river into Tombo West, and this year it seems to have moved again in a north-westerly direction and the centre now appears to be to the south of the Benue between Abinsi and Makurdi. At Wunnune the index was 412 and 364 on two farms, but the centre of the bad area was not visited.

Serious infestation still appears to be confined to areas where the gero is grown on the old yam heaps.

In the experimental area all farmers have appreciated early sowing. The scattering of the old heaps has had a mixed reception. Many farmers are very pleased with results and apparently have decided to adopt the innovation in future. Others say that they have had poor yields but that they expect to succeed with this method after a few years' trial. A few are definitely antagonistic. A few farmers outside the area, having heard of our methods, are trying them voluntarily.

Further acute famine is now improbable owing to the rapid extension of the cultivation of cassava and sweet potato. But even if the beetle disappears it will be some years before the cultivation of yams returns to normal.

Very few beetles have come to light. There seems to have been no definite migration this year, as occurred last season, probably owing to the more general distribution of rainfall through May and June.

Light traps consisting of a kerosene lamp standing in a bowl of water have not proved effective. A ring of ten of these traps was placed around one farm as it was hoped that the numbers of beetles taken in the various traps might indicate the direction of the migration. Though the lamps were lit for several weeks not a single beetle was captured even though a number of beetles were found in the farm.

An experiment with lemon grass, *Cymbopogon* sp., is being tried on the Experimental Station. Alternate rows of yams have been planted with the grass beside the seed yam.

Beetle attack on Water Yams is less than on the normal type.

An experiment with an early sown trap crop of yams is being tried on the School Farm, Abinsi. Only a few beetles were captured when the trap crop was dug up at the end of June and it remains to be seen whether this has had any effect.

One larva taken from a village rubbish heap has been reared to the pupal instar and both larva and pupa are very similar to those of *H. claudius*.

## SUGAR

### *Cane*

**Ceylon.**—The Divisional Agricultural Officer, Northern Division, reports that eleven different varieties of sugar canes are being tried at Allai Station. The varieties are Red top Mauritius, striped Tanna, No. 1237, No. 55P, No. 3390, No. 131P, Barbados 208, Cherribon DK74, striped white Tanna and Sunnambore. All the varieties except striped white Tanna and Sunnambore are doing well. The percentage of sugar in the Barbados is higher than that in others. Bullock power mills were used for crushing the canes and from the juice thus obtained jaggery is prepared.

Mr. A. W. R. Joachim, Agricultural Chemist to the Department of Agriculture, reports that eight samples of sugar cane were sent from the experimental station at Allai for analysis and report as to the degree of maturity and readiness for harvesting. Experiments were also undertaken to determine whether the residual cane juices from the canes examined could be utilised for the preparation of vinegar. The experiments have not yet reached the stage of successful completion.

### *Beet*

**Irish Free State.**—The Secretary, Department of Agriculture, reports that the following conclusions may be drawn from the results of a comprehensive series of varietal, manurial and cultivation tests with sugar beet which have been conducted over three seasons. (1) Kuhn P and Klinl Wanzleben Original Z varieties are more suitable for cultivation in Ireland than other varieties tested. (2) Whilst under unfavourable soil conditions benefit may be derived from the application after singling of a top-dressing of nitrate of soda at the rate of 1 cwt. per acre the use of a heavier top-dressing does not appear to be economical. (3) The application of well-rotted farm-yard manure in the drill immediately before sowing did

not appear to affect adversely the shape of the roots. (4) The best returns are likely to be obtained where the drills are 21 inches or less in width. (5) Singling of the crop should be carried out when the plants have developed four rough leaves.

## SPICES

### Ginger

**Nigeria.**—Mr. J. R. Mackie, Acting Assistant Director of Agriculture, Northern Provinces, states that, in view of the favourable report received from the Imperial Institute on samples of ginger from Southern Zaria, every effort is now being made to increase the production of this crop and at the same time to maintain the quality. An Officer is now touring this district and it is hoped that instead of a few cwts. the crop this year will amount to from 120–150 tons. It is proposed to purchase a commercial sample of the crop, which will be sent to the Imperial Institute for valuation.

**Sierra Leone.**—Manurial trials with ginger have been carried out at the Njala Experimental Farm. The yield of ginger from last year's crop was as follows :

Manure.	Section No.	Yield in lb. per tenth acre.
NPK and lime . . . . .	15	166½
	17	388½
NPK . . . . .	1	146
	8	158½
NP and Lime . . . . .	2	171
	9	276½
NP . . . . .	11	334½
	18	205½
NK and Lime . . . . .	4	348
	6	165
NK . . . . .	13	231½
	20	431
PK and Lime . . . . .	12	364
	19	359
PK . . . . .	3	575
	10	150
Control with Lime . . . . .	7	210½
	14	—
Control (no manure) . . . . .	5	512½
	16	246

## OIL SEEDS

### Coconuts

**Ceylon.**—Mr. N. K. Jardine, Inspector for Plant Pests and Diseases (Central), reports that the leaf-eating caterpillar *Nephantis serinopa* Meyr., the black beetle *Oryctes rhinoceros* L., and the red weevil *Rhynchophorus ferrugineus*

F. are the most serious insect pests of coconuts in the Central Division; they are declared pests under the Plant Protection Ordinance and consequently receive close attention. The rats, *Rattus rattus khandianus* and *Rattus rattus nemoralis*, are considered, by Mr. Jardine, to be responsible for a large proportion of "nut-fall."

According to Mr. W. R. C. Paul, Acting Plant Pest Inspector (Southern), the main coconut pest in the Southern Division is the red weevil (*Rhynchophorus ferrugineus*), which is serious in the Matara district where several young trees have been destroyed. It has been recently discovered that this pest not only breeds in the living palm but also can live in the tissues of a palm which has been felled and allowed to lie on the ground for two months. On splitting these stems, which were, however, not fully mature, several grubs were found to be present. Black beetle (*Oryctes rhinoceros*) is common throughout the district, but is rarely found doing any serious damage to palms. Coconut caterpillar (*Nephantis serinopa*) occurs to a slight extent on a small scale near Kosgoda.

A few occurrences of *Thielavopsis paradoxa* on coconut stems have been noted in the Tangalle area (Southern Division), but the progress of the disease has been slow and the fungus did not prove to be very active.

Mr. C. N. E. J. de Mel, Plant Pest Inspector (North-Western), in his half-yearly report on pests and diseases recorded in the North-Western Division, points out that *Oryctes rhinoceros* (black beetle of coconuts) can be controlled by keeping lands free of decaying logs, manure and refuse. This beetle breeds in coconut branches and husks if buried in trenches, especially on porous soils. *Rhynchophorus ferrugineus* (red weevil) which has not hitherto been found on a large scale, is somewhat on the increase. It attacks mostly healthy young plants between eight and fifteen years. *Nephantis serinopa* (coconut caterpillar) has long been established in the North-Western Division—over twenty years. It is, however, well controlled by parasites and by climatic conditions. An investigation into the life-history of this caterpillar (under the conditions of the North-Western Province) and the habits of the parasites was made in collaboration with the First Assistant in Entomology. It was found that a Eulophid parasite is the most common, and is found in large quantities in the case of an advanced attack. In this connection, Dr. J. C. Hutson, Entomologist to the Department of Agriculture, reports that it has first of all been necessary to breed a sufficient number of parasite-free caterpillars for use as possible hosts, one of the main

objects of the investigation being to ascertain at what stage or stages of its development *Nephantis* is attacked by this parasite. Incidentally, further information is being obtained on the bionomics of *Nephantis*. Observations are being made on the habits and development of the Eulophid parasite in relation to its host and a study will also be made of the bionomics of other parasites of *Nephantis*, as material becomes available.

Of the diseases occurring in the North-Western Division, grey blight (*Pestalozzia palmarum*) is found everywhere and does harm to young plants, especially on sandy and gravelly soils. The stem bleeding disease (*Thielaviopsis paradoxa*) occasionally does damage and a few cases of bud rot (*Phytophthora* sp.) occur from time to time.

**Gold Coast.**—According to the Acting Director of Agriculture the possibilities of a coconut industry on the coastal belt are being considered and it appears that suitable areas to concentrate on exist at Keta in the south-east of the Colony, and in the south-western corner from Axim to Half Assinie.

Experiments on copra drying in the sun without the use of expensive outfit and also with copra driers to determine the type best adapted to local conditions and most suitable for small proprietors are in progress at the Government plantations at Atwabo (Western Province) and Labadi (Eastern Province).

The defects found in local copra are being studied and a suitable method of sampling copra before export is being devised.

**Federated Malay States.**—The Acting Secretary for Agriculture reports that selection, manurial, cultural and cropping experiments have been continued at the Station, Klang, Selangor. Additional data regarding variation in oil content of copra have been compiled.

The results of the investigations regarding the alleged inferiority of Straits copra show that there is no appreciable difference between the oil contents of samples of copra from large estates, although native copra is frequently lower in oil content on account of the nuts being picked before they are ripe.

#### *Ground-nuts*

**Ceylon.**—According to the Divisional Agricultural Officer, Northern Division, the following varieties of ground-nut were successfully grown in Jaffna and Vavuniya—South Arcot, Triple Nut, North Arcot and Single Nut.



Of these North Arcot gave the highest return (2,960 lb. per acre).

### *Oil Palm*

**Ceylon.**—The Divisional Agricultural Officer, Northern Division, reports that the oil palms at the Anuradhapura Experiment Station are continuing to give increasing yields. Pruning the palms and pollination of flowers are being done. The yields, however, do not compare well with those obtained in Africa.

**Gold Coast.**—According to the Acting Secretary for Agriculture, the classification of the local varieties of oil palms is in progress with a view to the selection of the most suitable types and for comparison with the Deli type.

Experiments on germination and rate of growth are still in progress and will be reported on later.

A survey of the oil palm belt, to ascertain the distribution and the most suitable areas for concentration, has been commenced on the lines laid down for the revision of the cocoa distribution map referred to on p. 438.

**Federated Malay States.**—The Acting Secretary for Agriculture reports that with a view to making observations on the yield and quality of the fruit for the purpose of carrying out selection and breeding experiments on the oil palm, 22 varieties of oil palm from Africa have been planted on  $1\frac{1}{2}$  acre plots at the Experimental Plantation, Serdang. At the same time, the Economic Botanist is investigating the variation in fruit characters of the oil palm.

An investigation regarding the increase in acidity of palm oil on storage has been commenced. The results to date indicate that the acidity increases between 0.2 and 0.3 per cent. during two months. A series of experiments regarding the total losses of oil occurring in the purification of the oil and the treatment of the sludge has been commenced. As far as can be ascertained, the total loss, calculated on the weight of fresh fruit, amounts to between 0.2 and 0.3 per cent.

**Nigeria.**—The following report on the palm oil work during the first half of 1928 has been submitted by Mr. Manlove. The experiments on oil expression by the cooker-press method have been continued, but attention has been largely confined to small cheap hand presses both of the lever and of the screw types. In these experiments the native process has been maintained as far as

is compatible with the standard of product required. The cutting and picking of the bunches, the mashing and picking of the sterilised fruit, the heating of the mashed fibre prior to pressing and the final "refining" of the oil have been carried out by natives and with native-made implements. The presses have been compared with each other and with heavier presses, and the yields checked by laboratory analyses of fruit, press-cake and oil. Certain variations in pressing conditions, notably retention and removal of nuts before pressing, have also been tested. The fruit used has been obtained entirely from plantation trees, and harvesting records, including number of bunches, weight of fruit and yield of oil, have been kept. The nuts have been used in the cracking and separating work.

At present tests are being made on small power cracking and dry separating plant driven by a  $1\frac{1}{2}$  h.p. motor. A series of experiments is being started comparing the conditions of pre-treatment of the nut with the cracking efficiency in standard cracker. The separation tests, which are at present being carried out, consist in the determination of the efficiency of various types of separator: it is proposed to compare these results with those from wet separation methods.

Mr. C. H. G. Smith, Botanist, Department of Agriculture, reports that as a first step towards an attempt to start breeding superior types of oil palms, the individual yields of the Department's plantation palms at Calabar are being analysed. Figures for individual tree yields are available since the middle of 1922, and while the general average is low certain trees have given outstanding returns. An attempt is being made to determine which is the best type of fruit to concentrate on.

## ESSENTIAL OILS

### *Citronella*

**Ceylon.**—The Senior Agricultural Instructor, Batticaloa District, reports that citronella has been grown successfully in the comparatively dry climate of this district. A still has been erected and the following varieties of grasses distilled (arranged in order of oil yield): (1) Ceylon, (2) Lena Batu, (3) Matara Local, (4) Java, (5) Peradeniya.

According to Mr. A. W. R. Joachim, Agricultural Chemist to the Department of Agriculture, six samples of citronella oils from the experiment station at Batticaloa were examined and reported on. The "local Damana" citronella oil does not appear to be a citronella oil at all, but a sort of "Mana" oil. It had a geraniol content

of only about 26 per cent., as compared with an average of about 57 per cent. for oils from other Ceylon citronella grasses grown there and 81.5 per cent. for a sample of Java citronella oil.

The Acting Divisional Agricultural Officer, Southern Division, reports that the data of three years' figures of the yields of four types of citronella grass grown at the Borala Experiment Station (Matara District) have been carefully examined. These were Maha pengiri (Java variety), Maha pengiri (local variety), Lena batu (or Heen) pengiri, and Mana pengiri. The results prove without doubt the definite superiority of the Maha-pengiri (Java variety) over the other varieties cultivated and show an increase of just over 76 per cent. in yield of oil over the local variety (Lena-batu pengiri).

## FIBRES

### *Cotton*

**Ceylon.**—The Acting Divisional Agricultural Officer, Southern Division, reports that the area under cotton in the Hambantota District showed a slight decrease this season compared with 1926-27, but despite this fact the crop of seed-cotton harvested showed an increase of  $2\frac{1}{4}$  cwts. on the 1926-27 crop. The season was not a particularly good one for cotton, and it is estimated that the crop would have been over 2,500 cwts. but for unpropitious weather and serious damage to parts of the cotton area by herds of elephants. Too little rain during the sowing period, followed by a short drought, and too high a rainfall during the latter part of the growing and flowering period led to particularly vigorous vegetative growth with poor and late development of bolls. Shedding was in evidence throughout the fruiting period, but was neither serious nor abundant at any particular time or place. The movement of herds of elephants from the Magam Paruru game sanctuary area eastward into East Giruwa Pattu, through some of the best cotton-producing villages, led to the abandonment of many cultivations, in some cases before the final picking of the first crop was completed. Taking into consideration this factor and the unsuitable distribution of the rainfall the crop is satisfactory, and it is expected that double the present acreage will be cultivated in cotton next season. Work on the cotton stations has been satisfactory and progress has been made with rotation crops and with selection work. Earlier maturing varieties of Cambodia and specially selected local strains have shown considerably increased

yields over the ordinary types, the yields of which have shown a distinct tendency to decrease. Manurial experiments carried out on one station last season have not shown conclusive results and will be continued on all stations next season.

Cotton was tried at Vavuniya and Anuradhapura Stations in the Northern Division last season. The crop suffered from the attack of leaf rollers. A yield of 434 lb. of cotton has so far been obtained from one acre.

An experiment with cotton at Embilipitiya Ratnapura District was continued for the fifth time in the same land, this time as a rotation crop. The offer of Crown Chenas to village cultivators on easy terms on the understanding that half the land so allowed is cultivated with cotton attracted a good many cultivators for the third time at Embilipitiya. In accordance with the undertaking given to them, the Agricultural Instructor, Godakawela, was deputed to buy the villagers' cotton at the spot at Rs.18/- per cwt., less transport charges to Colombo, from funds advanced by the Spinning and Weaving Mills Ltd., to whom the seed-cotton was despatched. The total quantity despatched was a little over six tons. There is every possibility of extending the cultivation of cotton in Kolonna Korale.

**Leeward Islands.**—*Montserrat.*—Mr. C. A. Gomez, Curator of the Experiment Station, reports that an increase in the cotton-breeding work took place during the 1928 cotton-planting season. This was due to the many lines of special investigation work in the perpetuation of the best Heaton sub-types of Sea Island cotton with the view to breeding out, as far as possible, any further improvements in yield and quality that may be in the genetic composition of this already high-yielding type of Sea Island cotton. To this end 59 progeny rows were grown. In each row 30 plant selections were made from each row, thus 1,570 isolations are under investigation this season. The chief factors on which the breeding work is based are as follows: habit of tree, boll loculi, shedding, lint length, lint index, seed weight, percentage lint, bolls per lb., seed-cotton, lint per boll, etc.

The self-fertilisation of all flowers produced in the breeding plots from the selected and unselected trees was successfully carried out, so that the chances of hybridisation were eliminated.

A cotton gin presented by the British Cotton Growing

Association was installed and a small cotton ginnery for handling breeding-plot cotton was erected. With this small factory the cotton-breeding station of the Island may be said to be well fitted now for the pursuance of this high standard of cotton-breeding work.

**Nigeria.**—Mr. J. R. Mackie, Acting Assistant Director of Agriculture, Northern Provinces, reports that the Botanists are working steadily to improve the quality of the American cotton produced in Northern Nigeria. They have isolated at least one superior strain and this is now being multiplied as rapidly as possible. In addition, the seed of two improved strains from India, namely strains 285 F and 289 F, were recently received, and have been planted on isolation plots.

Seed distribution for the new season's crop has been completed, and given favourable climatic conditions everything points to a much bigger crop than last year.

Mr. O. B. Lean, Entomologist, Department of Agriculture, reports that until the close of the cotton season Mr. Golding continued his survey of factors inhibiting the growth of cotton at Ilorin. These investigations were especially important since they embrace the first survey of factors affecting the improved Ishan A. cotton.

The cotton season at Ilorin was especially interesting because of the marked absence of stainers (*Dysdercus* spp.), and because several other insects, notably *Nezara viridula*, were observed for the first time in Nigeria to be major pests.

A full account and summary of these investigations are given in a paper submitted by Mr. Golding for publication in the *Annual Bulletin* of the Department.

Mr. G. H. Jones, Acting Senior Mycologist, Department of Agriculture, reports that experiments for the completest possible external disinfection of cotton seeds for the attempted control of seed-borne disease (especially of the bacterial disease caused by *Pseudomonas malvacearum*) have been carried out. Germisan, in different concentrations and carried in suspension or solution in various liquids, has been chiefly used, as this gives both a primary and a secondary fungicidal action. Some of these treatments are now being tested in the field at Ilorin, Northern Nigeria.

**Nyasaland.**—Mr. C. B. R. King, Cotton Entomologist, reports that the main problem tackled during the first half year of 1928 was that of the Red (Sudan) bollworm.

The only measure for its suppression undertaken experimentally was the use of light traps to catch the moths. In 1927 a single burner, acetylene, was used, which arrived about half way through the season. In regard to this burner, it was found to be ineffective during the second week of the moon. This year, 2-4 burners were used, and it was found that 4 burners gave satisfactory control during the moon's second phase.

In the experiments this year, four burners (according to the makers, about 200 C.P.), were used in a plot of 5 acres which had cotton in 1926; and a similar trap was utilised nightly in the five acres which were under cotton last year, about 300 yards away. The latter was to catch all emerging moths from this plot to stop them flying to the present season's plot. This proved successful, 77 males and 32 females being taken during the rainy season.

As regards the plot laid down this year, a much larger number of moths were caught—158 males and 86 females, and it was ascertained that nearly, if not quite, all these moths were a carry-over from the 1926 season, a fact which had been suspected before from the long periods passed in the pupal state.

All females taken were gravid.

It was found also that moths of *Chloridea obsoleta* (American bollworm) were caught in the traps having four burners, both sexes being taken.

The moths of *Earias* (gravid females and males) were sometimes caught, and sometimes not, even when they were numerous in the cotton.

Owing to a five weeks' drought after planting, much of the cotton died, resulting in about a 66 per cent. stand, so that the yield to date, namely 2,800 lb. of seed-cotton from the five acres, may be considered satisfactory. Very little damage was done by the red bollworm. Bollworm losses on the whole were slight.

**Swaziland.**—*Season.*—The following report has been furnished by Mr. R. McDonald, Cotton Specialist to the Swaziland Government, in respect of the first six months of 1928.

*Season.*—The past season has been in most parts of Swaziland more satisfactory than the two previous seasons. The total rainfall over the greater part of the cotton-growing area would have been sufficient to produce good results, had its distribution been more even. Unfortunately the distribution was most erratic, in some cases 16 inches, or more than half the total rainfall registered during the season, fell during the first fortnight of January. Follow-

ing on this came a drought in February and March, only partially relieved by light showers in April. Nevertheless the April showers in most cases in the middle veld were sufficient to revive the cotton, and cause a big increase in the final yield.

*Crop.*—About 8,000 acres were under cotton in Swaziland this season, and of those roughly 300 acres, scattered throughout the country, were planted with jassid-resistant seed of strains selected by Mr. Parnell at the Barberton Station. This area has shown no sign of jassid attack, and in addition this variety of cotton has shown itself to be a very good drought resister, producing lint of remarkable strength. Re-selections in this variety have been bulked up during the current season, and the seed will be distributed in small quantities throughout Swaziland before next planting season. Provided economical use is made of this seed there ought to be about 5,000 acres under jassid-resistant strains next season. The remaining 7,700 acres of cotton were under Uganda, Improved Bancroft and Zululand Hybrid, all of which suffered severely from jassid attack.

*Pests.*—Jassid was first observed about the middle of January and spread rapidly throughout the whole cotton-growing area. Over the whole of the low veld the crop suffered very severely, but did not suffer to quite the same extent on the higher altitudes. The control of jassid so far as cotton is concerned appears to be in a fair way to solution through growing resistant strains, and by the end of next season it is hoped there will be sufficient seed to plant the whole area under resistant strains.

The incidence of red bollworm has not been general during the past season, although a few individual farms have suffered severely.

Spiny bollworm was not observed in any numbers since the early part of the season, and may be said to have done no damage to the crop.

No absolute measures of control have yet been evolved for bollworm, but the provision of trap crops which can be grazed or cut down periodically, may considerably reduce the numbers. To give this protective measure the best chance of succeeding, it may be necessary to grow a rapidly bolting cotton, such as Barberton U.4, in preference to the slower, big-bolled varieties.

The incidence of cotton stainer, like that of bollworm, has varied considerably during the past season. On the low veld where the crop was picked early little damage was done.

On the higher altitudes the April rains produced a

top crop which ripened late, and suffered rather more, but on the whole the crop has not suffered to any great extent.

**Uganda.**—Mr. G. W. Nye, Cotton Botanist, has furnished the following summary of experimental work on cotton carried out during the first six months of 1928. He points out that he was fortunate in having the very able assistance of Mr. Stephens from October until the middle of February, when the latter was required for famine relief work.

*Climate.*—The season 1927-28 may be classed as a very dry one and it showed very clearly the great drought-resisting powers of the cotton plant. It also afforded at Serere a very good example of the yields which can be obtained in a dry year by constant stirring of the surface soil to prevent excessive evaporation.

The effect of the dry spell in October was shown in the flowering curves, as the peak was fully a month earlier than in the previous, i.e., in mid-October instead of mid-November. The rains and cool weather in November resulted in a very rapid drop in the rate of flowering which then increased to give another peak in December.

The conditions at the time of planting most of the experimental plots were very dry and as a result the germination was generally poor.

*Selection Work.*—1. *Progeny Rows.*—Fifty rows, each of 35 plants, were sown in July; these included several new varieties, viz.: Arizona (from Rhodesia), Bancroft (from South Africa), and Kasch, Mebane and Acala (from the United States); most of the selections which had failed in the progeny rows in the previous year owing to adverse weather conditions; and ten selections made at the Bukalasa Experiment Station. All the rows yielded exceptionally well, with the exception of the new varieties, which suffered badly from jassid attacks, and the five selections of Meade cotton made at Bukalasa. Over 40,000 bolls were examined in the laboratory for the usual characters.

The results from all strains are not yet available, but two strains which have been analysed, S.G. 23.5 and S.G. 21.5, show a very much lower boll-shedding rate than most strains. They both gave a boll-shedding rate of under 45 per cent.; while most other strains averaged from 55 to 70 per cent. the average shedding of the main crop was about 56 per cent. S.G. 23.8 is a very promising strain, as, apart from the above character, it is a potential high yielder as regards lint weight per boll and the staple



is satisfactory. Unfortunately the strain S.G. 21.5 has very small bolls and gives a low lint index. The strain B.1 from Bukalasa yielded very well and gave lint of excellent quality with a staple of full  $1\frac{5}{8}$  in. This strain and S.G. 23.8 will be grown in small bulk increase plots in the coming season.

The only serious pest on the selection plot was an attack of jassid which, as already mentioned, ruined most of the new varieties. Stainers were non-existent until the end of the season when a few *Oxycarenus* appeared. Very little black-arm or angular leaf spot was observed.

2. *Small Bulk Increase Plots*.—Owing to the failure of the progeny rows in the previous year no selections could be made for increase plots, but a  $\frac{1}{4}$ -acre plot of a strain of the Salisbury variety, S.G.7, was planted to provide a supply of seed for trial on the poor sandy soils of Usuku and Nepak counties where the finer cottons give very poor yields. An analysis of bolls from this plot gave the following results :

	Loculus No	Seeds per boll	Lint wt per boll	Seed wt per boll	Lint length	Lint index	G O T
S.G.7	4.21	31.08	1.83 gm.	4.03 gm.	27.7 mm.	5.8	34.1

These figures indicate that the strain is a high-yielding type with a staple of  $1\frac{1}{8}$  in. The yield was at the rate of 514 lb. per acre, which is very high considering that the plot possesses the poorest soil on the plantation. The broker's report on this cotton is as follows: "Strict good middling, light creamy colour. Good  $1\frac{1}{8}$  staple, strong, rather wanting in fineness and lustre. 300 points on."

3. *Medium Bulk Increase Plots*.—Of the previous season's small bulk increase plots three were selected for further propagation, namely, S.G.29 for its high-yielding powers, S.G.15 on account of a good broker's report and S.G.26 as a result of a favourable spinning report.

S.M.G.29.—Of this strain six acres were sown in July at a spacing of 5 ft.  $\times$  2 ft. The germination was very poor owing to dry conditions after sowing and as a result a very poor stand was obtained. This poor stand makes the total yield of 4,954 lb. or 812 lb. per acre all the more remarkable, and it has been decided to carry on with this strain, increasing the bulk as rapidly as possible; over 200 acres will be grown this year in segregated plots and it is hoped that sufficient seed will be obtained to sow the gombololas of Kadunguru and Labori in 1929.

Bolls were examined from this plot and the figures are given in the table below.

	Loculus No.	Seed per boll.	Lint wt. per boll.	Seed wt. per boll.	Lint length.	Lint Index.
S.G.26	3.96	30.6	1.64 gm.	2.96 gm.	30.3 mm.	5.35
S.G.29	4.03	31.49	1.86 gm.	3.30 gm.	31.0 mm.	5.9

The broker's report is as follows: "Strict good middling, creamy colour. Staple about  $1\frac{3}{16}$ , strong, silky and lustrous. 400 points on."

The strain is maintaining its regularity in staple and boll characters and is altogether rather promising.

S.G.26.—It was not originally intended to grow this strain in bulk, but a favourable spinning report arrived just in time to enable 1.8 acres to be sown in mid-August. Despite the late sowing this strain yielded at the rate of 847 lb. per acre. It is, however, not so satisfactory as S.G.29. The summary of the boll characters are included in the table above.

The broker's report was as follows: "Strict good middling, creamy colour. Strong, staple  $1\frac{1}{8}$  to  $1\frac{5}{16}$ , irregular, fairly lustrous and fine. 350 points on."

S.G.15.—2.8 acres of this strain were sown in July and the yield worked out at 905 lb. per acre, which was astonishing, as this strain has not shown high-yielding characters. The yield trials against other varieties confirmed the fact that normally this cotton is a low yielder and is susceptible to jassid attack, in fact it was possible to pick out the plots of this strain from a distance owing to the yellowing of the leaves from jassid attacks. The broker's report was again very satisfactory: "Strict good middling, creamy colour. Full  $1\frac{3}{16}$  staple, strong, silky and lustrous. 450 points on."

It will be interesting to see if the spinning tests are again unfavourable.

*Field Experiments.* 1. *Variety Trials.*—Yield trials with several of the new strains and N.17 and N.19 were conducted at Serere, Bukalasa, Kampala and Ngetta, while smaller trials were conducted at Simsa, Achuna and Labori.

At Serere observation rows were demarcated in each plot and complete growth, flowering and bolling records taken; the results from these show that S.G.27 is probably the highest yielding of the new strains; the order of yield given by these rows was as follows:

- |           |           |
|-----------|-----------|
| 1. S.G.27 | 4. N.19   |
| 2. S.G.26 | 5. N.17   |
| 3. S.G.29 | 6. S.G.15 |

In the results from the actual plots themselves which are summarised in the table below, S.G.15 was significantly lower yielding than any of the other strains at Serere.

YIELD IN MEAN LB. PER 1/20 ACRE PLOT (MEAN OF 5 PLOTS PER STRAIN)

Site of Trial	N 17	N 19	S G 15	S G 26	S G 27	S G 29	N 3/5	Local.
Serere . . .	45.0	44.2	33.6	46.5	44.6	45.0	—	—
Ngetta . . .	28.6	28.4	—	—	30.0	27.6	—	—
Bukalasa <sup>1</sup> . . .	—	19.0	15.4	—	—	20.8	23.8	—
Kampala . . .	7.5	3.5	3.6	—	—	—	3.0	5.5
Simsa . . .	27.6	—	22.0	—	—	26.0	—	—
Labori . . .	45.2	—	38.4	—	—	—	—	—

<sup>1</sup> These plots were  $\frac{1}{4}$  acre in extent.

2. *Sowing Date and Spacing Experiments.*—The experiments on these points conducted at Serere, were continued, with the addition of two spacings. A great mass of data has been obtained from the observation rows in these plots and it has not been possible to commence the analysis of them. June sowing showed superiority over July sown and a very great increase in yield over August sown. The closer spacings gave higher yields than the normal 4.2 and wider spacings, and although this was expected in the case of the later sown cottons it was thought probable that the early sowings would require wide spacing owing to the longer period for vegetative growth. The explanation of this is to be found in the examination of the meteorological records and observation row data, which show that the dry periods prevented the production of many vegetative branches. The summary of the plot figures from this experiment is given in the table on p. 469.

A similar sowing date and spacing experiment to the above was conducted at Bukalasa and from the figures given it will be seen that the results are very similar to those obtained at Serere. Ordinary spacing experiments were conducted at Ngetta, and various districts in Lango and Teso, the results of which are also summarised in the table. In all cases N.17 seed was used in these experiments, whilst at Simsa, S.G.29 and S.G.15 were used in addition.

These results give in almost every case a balance in favour of close spacing, especially in Lango. This is possibly due to the very dry weather experienced and before any definite recommendations can be put forward it will be necessary to obtain results from wet years.

Apart from the actual purpose of these experiments the figures are of great interest in showing very clearly

YIELD IN MEAN LB. PER 1/20 ACRE PLOT (MEAN OF 5 PLOTS)

Site of Experiment.	Spacing in feet.						
	5 × 21	4 × 21	4 × 23	4 × 12	3 × 21	3 × 23	3 × 12
Serere : Sown in June .	25.7	25.6	25.5	27.7	29.5	27.7	31.2
"    July .	19.7	23.5	21.4	24.9	24.3	27.6	22.6
"    August	8.1	8.5	10.6	12.3	13.4	14.1	13.7
Bukalasa : Sown July 15	—	30.2	26.6	43.2	—	45.4	43.6
"    July 31	—	26.6	29.0	40.8	—	36.0	32.4
"    August 31	—	24.0	18.4	26.2	—	25.4	26.2
Lango							
Ngetta . . .	—	—	38.4	—	—	—	40.4
Kabermado . . .	—	—	10.6	—	—	—	54.2
Aduku . . .	—	—	26.8	—	—	—	32.8
Dokolo . . .	—	—	11.8	—	—	—	17.6
Teso							
Achuna . . .	—	—	26.4	—	—	—	27.6
Katini . . .	—	—	19.2	—	—	—	20.0
Labori . . .	—	—	45.2	—	—	—	44.0
Tira . . .	—	—	29.6	—	—	—	33.4
Nyero . . .	—	—	13.6	—	—	—	15.8
Katakwi . . .	—	—	10.0	—	—	—	10.9
Kyere . . .	—	—	26.4	—	—	—	24.4
Simsa, N.17 . . .	—	—	27.6	—	—	—	30.8
"    S.G.29 . . .	—	—	26.0	—	—	—	26.2
"    S.G.15 . . .	—	—	22.0	—	—	—	27.2

<sup>1</sup> Two plants per hole.<sup>2</sup> One plant per hole.

how the yield varies from place to place even within narrow limits.

*Sulphuric Acid Experiment.*—This was repeated in the laboratory and also was extended to field trials, when the results in favour of acid treatment of seed of the previous year were confirmed. Statistical treatment of the germination percentages showed a very significant increase in germination due to treatment. Growth, flowering and bolling records were taken from the plots treated and untreated in the field and, apart from the more rapid growth in the initial stages of the treated seed and a better stand, no difference was obtained and certainly no adverse effect on boll production or lint quality was observed.

The results obtained during the 1927–28 season may be briefly summarised as follows :

1. The season was very satisfactory from the experimental point of view and served to emphasise the necessity of frequent inter-cultivation.

2. Pests and diseases were practically absent with the exception of jassids.

3. Two strains with low boll-shedding rates have been isolated and it will be of interest to see if this character persists in the coming season.

4. S.G.29 is a very promising strain and is being grown in bulk for limited distribution.

5. The sowing date experiment again showed the advantage of early sowing due in this season to the very dry weather later in the year.

6. The spacing experiments indicate the advantages of closer spacing in nearly every area in which they were conducted.

7. Samples of seed-cotton received from cotton-producing areas are satisfactory, but give indications of deterioration of the N.17 strain in some areas owing to intercrossing and mixture of seed which is very difficult to control.

The following report on the main crop of cotton grown on the Serere Plantation has been made by Mr. P. Chandler, Plantation Manager.

1927-28 *Crop*.—The area devoted to the main crop was 25 acres, 24 acres of which were sown with selection No. 19, the remainder with No. 32. Most of the area was July sown, the spacing distance being 4 ft. between the rows, and  $1\frac{1}{2}$  ft. from plant to plant. The slightly closer spacing employed proved an advantage owing to the drier season, with the result that the plants were less woody than usual and gave a higher yield. The average yield for the whole 25 acres was slightly over 600 lb. of seed-cotton per acre. The picking season lasted over a period of 19 weeks, the final pickings being made on March 15.

1928-29 *Season*.—This year it is hoped to increase the main crop area slightly, bringing it up to at least 35 acres. The variety grown is a selection (No. 29), made by the Cotton Botanist. Fourteen acres have so far been sown, sowing having commenced on June 19. The spacing distance will generally be 4 ft. between the rows, with 2 ft. between the plants in the rows. The first 5 acres, however, of a 10-acre block have been sown a little wider between the rows, viz. 5 ft., at the suggestion of the Cotton Botanist. Economy of seed in sowing has been studied in order to make the limited amount available go as far as possible by sowing two seeds only per hole, with the result that less than 26 lb. proved sufficient to sow the 10 acres at the spacings mentioned above. Calculations made showed that there were rather more than 4,000 seeds of this particular type of cotton seed to the pound. At the time the report was written germination

was very good, but a few blanks were visible due to insect attacks both above and below the soil surface. Insects resembling species of wireworms have been found near the roots of some young plants observed to have been attacked.

### *Sisal*

**Ceylon.**—The Divisional Agricultural Officer, Central Division, reports that a one-acre block of sisal hemp has been established at Nalanda Station, and the growth has been remarkably good. The villagers, however, have not taken to this crop in spite of the free offer of suckers that are available.

The extraction of sisal fibre at the Experiment Station, Anuradhapura, Northern Division, was resumed early in March. The output of dry fibre for the half-year was 5 tons of first-quality fibre and 11 cwts. of tow.

**Federated Malay States.**—The Acting Secretary for Agriculture reports that the experiments at the Serdang Plantation to test the optimum period to allow between cutting of the leaves has been continued. The results for the first year of the experiment show no significant difference in either the yield or quality of the fibre produced, but it is too early to form any definite conclusions with regard to the experiment.

## RUBBER

### *Hevea*

**Ceylon.**—Mr. T. H. Holland, Manager of the Experiment Station, Peradeniya, reports that the tapping of the first area of budded rubber to come into bearing on the Station was started in May 1928. This acre block consists of 128 small clones budded in 1922 from the 12 trees in a block in which individual yields were recorded which had at that time given the highest yields. Individual yields of dry rubber are being recorded from these budded trees.

Budwood has been received from the Federated Malay States, Java and Sumatra, and budded on to nursery stocks for transmission to the Kegalle Experiment Station. In addition a number of buds from high-yielding trees on estates and at Heneratgoda Gardens have been budded on to nursery stocks for the formation of budwood nurseries.

Under a new scheme, financed by a grant from Rubber Restriction Funds, it has been arranged to open 80 acres of Experiment Station jungle for the purpose of testing

mother trees. Ten acres have already been cleared, terraced and planted with stumps to be budded in the field when ready.

**Uganda.**—Mr. A. B. Killick, Agricultural Officer, reports that selected Hevea trees are being tested for yields at the Kampala Plantation; the best trees will be used for budding purposes. Records were commenced in February 1926 with ten trees and the number has since been increased to 28. Of these, 5 are being discarded as the yields are too low; they have been under observation for 22 months. Three others are also being discarded for a similar reason after 14 months' observation. Of the remaining 20, the yields vary from about 8 lb. to 17½ lb. per annum, the latter rate of yield having been obtained from one tree over a period of 23 months. The tapping of all the trees is on one-third the surface on alternate days. One tree showed signs of brown bast disease, and this was discarded in January 1927.

#### *Jelutong (Dyera spp.)*

**Federated Malay States.**—The Acting Secretary for Agriculture reports that further experiments on the deterioration of jelutong have been carried out. These experiments have shown that the addition of very small amounts of iron to the latex before coagulation induces oxidation of the product with great rapidity. The results have been summarised for publication in the *Malayan Agricultural Journal*.

An investigation is in progress to determine the variations in the moisture contents of separate blocks of jelutong in a consignment.

#### TOBACCO

**Ceylon.**—The Divisional Agricultural Officer, Northern Division, reports that a successful attempt was made in the Jaffna Experiment Station to grow White Burley Tobacco, without irrigation, employing methods of dry farming. One hundred leaves of average size selected from the tobacco grown without irrigation weighed 8 per cent. more than the same number of leaves similarly selected from plants grown with irrigation. An appreciable improvement in the quality of the leaf, in points of colour, burning quality and body was noticeable. The result shows considerable promise in the direction of growing tobacco without irrigation.

The number of tobacco seedlings supplied to the cultivators in Jaffna amounted to 57,080. The grading

and bulking of tobacco received from cultivators was continued and the results so far received are as follows :

No. of cultivators.	No. of villages.	No. of plants.	Total quantity of cured leaves.	Total value.
107	18	61,382	11,074	Rs.8349/06

Mr. N. K. Jardine, Inspector for Plant Pests and Diseases (Central), reports that the leaf-eating caterpillar (*Prodenia litura* F.) and the stem-miner (*Phthorimæa heliopa* L.) have done considerable damage to tobacco in the Dumbara District ; eelworm, however, appears to be the most prevalent pest.

The first two insects and a species of Aphis are also recorded by Mr. C. N. E. J. de Mel from the North-Western Division, but the damage caused is negligible, except in the case of *Phthorimæa heliopa*, which is sometimes harmful.

**Leeward Islands. Montserrat.**—Mr. C. A. Gomez, Curator of the Experiment Station, reports that a number of types of tobacco were grown and cured for putting on the English market. Samples will soon be ready for submitting to the Imperial Institute and London brokers for valuation. Special manurial treatments were included in these tobacco experiments.

**Nyasaland.**—Mr. A. J. W. Hornby, Agricultural Chemist, reports that varieties of tobacco which he introduced

Rotation crops.	Green weight of tobacco per plot of $\frac{1}{4}$ acre.			
	Burley		Western.	
	lb.	No. of plants.	lb.	No. of plants.
1a. After Sunn hemp . . .	215	211	175	119
1b. " " " " . . .	242	146	205	97
2a. After Velvet beans . . .	241	126	214	109
2b. " " " " . . .	208	129	192	100
3a. After Tobacco " . . .	198	176	206	81
3b. " " " " . . .	214	132	183	108
4a. After Soy-beans . . .	225	189	245	98
4b. " " " " . . .	256	112	191	94
5a. After maize . . .	225	131	190	97
5b. " " " " . . .	216	93	196	114
6a. After tobacco . . .	249	175	202	97
6b. " " " " . . .	232	101	221	92
7a. After Sunn hemp . . .	166	125	216	124
7b. " " " " . . .	191	150	147	82
8a. After Bush Velvet Beans . . .	148	115	162	90
8b. " " " " " " . . .	156	134	160	87
9a. After Tobacco " . . .	141	104	135	84
9b. " " " " . . .	192	115	129	93
10a. After Soy-beans . . .	212	169	—	—
10b. " " " " . . .	213	124	—	—



in 1925 such as "Cash" and "Jamaica Wrapper" for flue-curing and "Melton" for fire-curing, continue to be increasingly popular and should be standard in certain areas for the production of types of Nyasaland tobacco.

Experiments were conducted during the season 1927-28 to ascertain the effect, if any, on the yield of tobacco grown after various rotation crops. The results with "Burley" and "Western" varieties are shown in the table on p. 473; two plots were grown in each case, that designated (a) received magnesian lime at the rate of 400 lb. per acre.

The tobacco on certain of the "Western" plots was graded and sold locally, the value of the grades being 1s. 1d., 11d., 8d., 7d. and 6d. per lb. respectively.

Plot.	Weight of grades in lb					Total.
	1	2	3	4	5	
1a	14	10	4	11	10	49
2a	14	13	9	4	4	44
3a	7	13	7	4	4	35
4a	14	7	13	4	3	41
4b	18	16	7	4	8	53
5a	14	14	20	2	4	54
6a	4	5	10	3	5	27
7a	7	10	13	3	5	38
9a	12	5	8	3	4	32

It will be seen that the effect of various rotation crops on the following tobacco is almost negligible when these crops are grown on newly opened land. There is practically no difference in the yield or quality of the tobacco from the various plots.

A series of tests were carried out during the seasons 1926-27 and 1927-28, to ascertain the effect of various ammonia manures on the yield of tobacco. Each plot received 20.6 lb. of nitrogen, 48 lb. of potash and 84 lb. of phosphoric oxide per acre, except that in 1926-27 one plot, manured with blood meal, received only 8.3 lb. of nitrogen per acre, but the full amount in 1927-28.

The results obtained are shown in the table on p. 475.

Plots Nos. 3, 5, 7, 8, 10, 12 and 14 received lime as double superphosphate while plot No. 15 received lime as precipitated bone phosphate in which forms the phosphoric oxide was supplied.

There is no reason to suppose as a result of these initial trials that the ammonia in urea, sulphate and phosphate of ammonia is of different fertilising value. Indications are that nitrogen in nitrate form, as in the potash salt,

No. of plot.	Nature of Ammonia Manure.	Yield per acre.		
		1926-27.		1927-28.
		Green Weight	Dry Weight	Green Weight
1	Diammonium Phosphate . .	2,130	430	5,880
2	No fertiliser . . . .	971	180	3,500
3	Ammonium Sulphate . . .	2,080	490	6,840
4	No fertiliser . . . .	811	170	3,400
5	Urea . . . . .	1,820	450	4,800
6	No fertiliser . . . .	1,030	220	3,980
7	Nitrate of Potash and Ammonium Sulphate . . .	2,720	608	6,840
8	Ammonium Sulphate . . .	2,380	540	5,880
9	No fertiliser . . . .	750	180	3,980
10	Nitrate of Potash and Urea . .	1,810	440	5,200
11	No fertiliser . . . .	690	190	2,720
12	Blood Meal Compound fertiliser .	1,060	260	5,160
13	No fertiliser . . . .	330 <sup>1</sup>	80 <sup>1</sup>	2,920
14	Ammonium Sulphate . . .	1,820	330	5,360
15	Ammonium Sulphate . . .	1,980	520	5,760

<sup>1</sup> This plot was attacked by eelworm in 1926-27.

will in certain years give the best results. It seems that about one-quarter of the nitrogen supplied to tobacco should be in this form as a side application up to twelve days after planting.

**Uganda.**—Mr. G. T. Philpott, Plantation Manager, Hoina Bunyoro, reports that a consignment of leaf from the first planting last year, consisting of 5 grades, was sold on the Liverpool market at a flat rate of 1s. 8½d. per lb. in January when Nyasaland top grades were quoted at about 1s. 10d.

As was anticipated, the crop from the second planting which was harvested at the end of the year was a failure, only 654 lb. of cured leaf being obtained from the two acres planted. The leaf was small and rather light and cured out a poor colour. The failure was due to the exceptionally dry weather experienced during the planting and growing seasons.

Experiments are now being confined to the trial of different varieties in order to ascertain the kinds most suitable for export and for local manufacture. Nurseries were sown on February 3, the following varieties being used: Blue Pryor, Western and Hickory Pryor, all from Nyasaland; B.I and B.II, selections from local-grown tobacco; and Piet Retief Swazie, the seed of which came from selected plants of the first crop last year. No troubles were experienced in the nurseries and the plants were ready for planting out at the beginning of April.

Weather conditions were excellent and the crop had made good progress up to the end of June.

### DYESTUFFS

#### *Annatto (Bixa Orellana)*

**Federated Malay States.**—The Acting Secretary for Agriculture reports that a consignment of about 10 cwts. of annatto was sent to London as a trial shipment, and was sold with difficulty at  $1\frac{1}{4}d.$  per lb., a price which is insufficient to cover cost of collection of the seed. This consignment was collected from a small area, necessitating storage before a sufficient quantity was available for shipment. In consequence it deteriorated somewhat. The supplies of annatto in London appear to be in excess of the demand, consequently the prices now being realised are not very remunerative.

### TANNING MATERIALS

#### *Gambier*

**Federated Malay States.**—The Acting Secretary for Agriculture reports that the experiments inaugurated to ascertain the optimum period to allow between the cutting of the leaves have been continued. From present results, it would appear that four months is the most suitable interval to allow between successive prunings.

### MISCELLANEOUS AGRICULTURAL PRODUCTS

#### *Tuba Root (Derris spp.)*

**Federated Malay States.**—The Acting Secretary for Agriculture reports that an experiment is in progress to ascertain the optimum age to harvest "tuba puteh" (*Derris elliptica*). Further areas have been planted with other varieties. The results of the investigation on tuba indicate that the variety *Derris malaccensis* contains a much greater percentage of toxic material than *Derris elliptica*.

### MINERAL RESOURCES

#### BRITISH GUIANA

In a half-yearly communication to the Director of the Imperial Institute, the Acting Commissioner of Lands and Mines reports that a geological survey of the more important diamond and gold areas of the Colony has been in progress during the past three years.

It is inferred that the location of the diamantiferous alluvium is directly related to the geological structure of the Guianan Highlands.

The Pakaraima Mountains, which, at Mount Roraima on the Brazilian boundary of the Colony, attain a height of 8,635 ft., terminate on their northern slopes in a series of bold scarps, one to two thousand feet high. From their base a low peneplain, almost covered by a deposit of white sand and clay of fairly uniform thickness and possibly of comparatively recent origin, extends almost uninterruptedly for some one hundred and thirty miles to the coast. The diamond-bearing alluvium is developed in the small creeks which dissect this deposit, which is partly marine in origin, in a fairly wide belt of country skirting the escarpment, and is undoubtedly genetically related to the Kaiteurian sedimentary formation which forms the bulk of the mountains.

Preliminary examinations have consequently been almost confined to this belt of country between Peaimah Fall in the Mazaruni River and the Konawaruk River, a distance of 140 miles. They have been extended into the mountains, however, as far as the boundary of the Colony at Ireng River.

The investigations indicate considerable diamond resources in the low peneplain, and the possibility of the presence of widespread deposits in the higher portions of the mountains, where, due to the intrusion of large bodies of basic igneous rocks into the sedimentary series with consequent dislocation and elevation of blocks of the latter, the propitious scarp conditions seen at the edge of the formation are repeated at higher levels.

The most important goldfield, that of Eagle Mountain in the Potaro district, has also been examined. Small creek deposits which have provided the bulk of the gold won from this district are practically exhausted, but it is now seen that many of these have derived their gold directly from extensive low hill deposits which are possibly related in origin to the marine deposits of the peneplain. These are now being systematically tested in the hope that they may be found suitable for larger-scale exploitation methods.

Just as the creek gold is here derived directly from the more extensive deposits in the peneplain bordering the igneous massif, so, it has been discovered, the diamonds of the small creeks are directly derived from the extensive sand deposits in the part of the peneplain skirting the sedimentary formations.

A report dealing with the work to date and with the

more detailed examinations now in progress is in course of preparation. Reports published to date are the following :

*Preliminary Survey of the Mazaruni and Puruni Diamond Fields of British Guiana*, by H. J. C. Conolly, Government Geologist, 1926 ; *Interim Report and Statement of Policy of Geological Survey*, by H. J. C. Conolly, Government Geologist, 1927 ; *Preliminary Geological Survey of the Potaro-Ireng District of British Guiana*, by S. Bracewell, Assistant Government Geologist, 1926.

### CYPRUS

In a communication from the Acting Colonial Secretary for Cyprus, the Director of the Imperial Institute has received the following report by the Inspector of Mines for Cyprus (Mr. H. G. Mountain) on the progress of mining on that Island for the six months ended June 30, 1928.

Work has been conducted without intermission at Skouriotissa for the six months under review, and the production of pyrites shows an increase on the tonnage for the corresponding period of 1927.

Development work at Mavrovouni is being pushed vigorously, and statistics are given below on the work done.

At Amiandos, quarrying was started towards the end of March, and the production of asbestos for the first six months of the year is well in advance of that for the corresponding period of last year.

The following statistics relate to the work done at the Skouriotissa pyrites mine of the Cyprus Mines Corporation during first half of 1928 as compared with the first half of 1927:

	1st 6 months 1928.	1st 6 months 1927.
Tonnage mined . . . . .	117,570	86,898
Mining operating labour (average per month) . . . . .	1,046	1,096
Tonnage exported . . . . .	114,895	108,391
Total surface and underground labour (average per month) . . . . .	1,378	1,594

The following are the statistics relating to development at the Mavrovouni pyrites mine of the Cyprus Mines Corporation for the six months under review, compared with figures for the corresponding period of 1927.

	1st 6 months 1928.	1st 6 months 1927.
Boreholes, footage sunk . . . . .	3,544	573
labour average per month . . . . .	31	88
Shafts, footage sunk . . . . .	216	—
labour average per month . . . . .	20	—
Main Adit, footage driven . . . . .	1,554	—
labour average per month . . . . .	61	—

The Mining Engineer of the Pyrites Company Limited arrived in the Island at the beginning of March and a start was made immediately on exploratory work at Kalavasso. A surveyor has also been sent out from England and is employed in the preparation of a complete contour survey of the area, as a guide to the proposed drilling campaign.

In addition to underground exploration at Mitsero, the Anonyme Hellenic Company have installed two drilling machines, one near the underground workings at Mitsero, and the second at Agrokippia. The latter has reached a small band of pyrite of fairly good grade. Arrangements are being made to work a third drill on an area near Ayia Marina.

Only a very small quantity of chrome has been exported for the six months and that for sample purposes. A party of German engineers, interested in the metal, visited and inspected several of the areas, and negotiations are being conducted which it is hoped will result in a mining engineer being sent out to examine and report on the various areas.

The Cyprus Mines Corporation exported 10 tons of copper precipitate during the six months under review.

During the first six months of the year the export of gypsum stone amounted to 195 tons, and that of calcined gypsum to 4,950 tons, as compared with 467 tons and 6,800 tons for the corresponding period of last year.

The following statistics relate to the work of the Cyprus Asbestos Company Ltd. for the first six months of the year, compared with the first six months of 1927.

	1st 6 months 1928	1st 6 months 1927
Tonnage mined (rock) . . .	796,769	409,183
Average monthly labour . . .	3,295	2,257
Tonnage exported (asbestos) . . .	3,661	1,581

The Company are erecting a further primary mill, which is now nearing completion, and their output for 1928 should easily reach their estimated figure of 15,000 tons.

During the first six months of the year, 2,341 tons of "terra umbra" were exported as compared with 2,248 tons for the corresponding period of 1927.

It will be seen that, with the sole exception of gypsum, the export of mineral has been well in advance of last year, and with the two larger mines showing a substantial increase, the upward grade of yearly mineral output from the Island should be well maintained.

## FEDERATED MALAY STATES

The Director of the Imperial Institute has received from the Director of the Geological Survey of the Federated Malay States (Mr. J. B. Scrivenor) the following half-yearly report on research work in his Department during the period January 1 to June 30, 1928 :

*Magnetic Cassiterite.*—Mr. J. C. Shenton has completed analyses of magnetic and non-magnetic cassiterite from the Sungei Besi Mines Limited property in Selangor. The sample analysed was taken from the concentrated ore as sold to the smelters. It was divided into a magnetic and non-magnetic portion by means of a laboratory electro-magnet.

After grinding, the magnetic portion was much darker in colour than the non-magnetic portion, which was almost white. The magnetic portion after treatment with hydrochloric and nitric acids for one week was more magnetic than before. The non-magnetic portion after similar treatment was still non-magnetic. The magnetic portion, after heating to bright redness, was still magnetic on cooling.

Mr. Shenton's analyses are as follows :

	Magnetic. <i>Per cent.</i>	Non-magnetic. <i>Per cent.</i>
Silica . . . . .	0.620	0.812
Tantalum and columbium oxides . . . . .	0.088	0.112
Titanium oxide . . . . .	0.380	0.035
Antimony . . . . .	none	trace
Lead . . . . .	trace	trace
Copper . . . . .	none	none
Bismuth . . . . .	none	none
Zinc . . . . .	none	none
Arsenic . . . . .	trace	0.610
Ferric oxide . . . . .	1.190	0.800
Alumina . . . . .	0.040	0.060
Rare earths . . . . .	0.070	0.080
Lime . . . . .	0.082	0.070
Magnesia . . . . .	trace	trace
Sulphur . . . . .	trace	0.199
Stannic oxide by difference . . . . .	97.530	97.222
	<hr/> 100.000	<hr/> 100.000
Metallic tin by hydrogen reduction . . . . .	77.0	76.7
Stannic oxide . . . . .	97.75	97.38
Ferric oxide soluble in acid . . . . .	0.46	0.72
Ferric oxide insoluble in acid . . . . .	0.73	0.08

Neither of the above samples can be taken as pure cassiterite. The silica, for instance, is present as quartz and in zircon. In the non-magnetic portion the sulphur and some of the ferric oxide are accounted for by pyrite.

Mr. Shenton thinks that the magnetic properties of the magnetic portion are due to the large amount of iron in chemical combination with the cassiterite.

*Clay for Bricks, etc.*—Experimental work was carried out on local clays for making bricks, tiles and pipes. The results were not satisfactory, as Chinese kiln-owners had to be relied on for the firing. An experimental kiln, capable of taking forty bricks, is now being erected near to the Geological Survey Offices, where it can be controlled by the Chemist.

*Stannite.*—About the same time as the publication of *The Geology of Malayan Ore Deposits*, where it is stated that stannite has not been recorded in Kinta, Dr. F. T. Ingham, Mining Geologist, found a small specimen in a tin-deposit in limestone, in Kinta. It has been a puzzle why stannite should not be common in these limestone deposits, while other sulphides are abundant, so Mr. Shenton began a series of careful analyses, searching for tin soluble in acids in rich ore from deposits in limestone. So far two results have emerged : (1) if the ore is roasted before treatment with acid the free sulphur dioxide attacks the cassiterite and forms a film of soluble sulphide on the grains and crystals ; (2) avoiding any such error due to roasting it seems that some tin is present, in a form soluble in acids, in ore rich in metallic sulphides. The highest figure obtained was 1.3 per cent. in ore from Leong Sin Nam's Mines at Menglembu. It is very probable that this tin is present as stannite in such small quantity and so intimately intermixed with other sulphides that it is not noticeable to the naked eye.

## GOLD COAST

In a communication to the Director of the Imperial Institute, the Director of the Gold Coast Geological Survey (Sir Albert Kitson) sends some notes on deposits of bauxite, manganese and limestone found by the Geological Survey during the half-year ended June 30, 1928.

In the Yenahin district, some 35 to 40 miles west of Kumasi, the deposits of bauxite found by the Geological Survey in 1923 were further examined and tested by a few shafts. This work proves the deposit to be from 20 to 50 ft. thick, and to contain very large quantities of good bauxite.

Associated with the good ore are patches of highly ferriferous bauxite. The mode of origin is similar to that of the bauxite of the Sefwi Bekwai district, viz. derivation



from altered sedimentary rocks, and from volcanic rocks as well.

Associated with the Yenahin bauxite in one locality are large masses of manganese ore, some of which is of high grade. Before a satisfactory opinion can be obtained of the value of this occurrence much further work will have to be done upon it.

Between Okraji and Asuboni, on and beside the motor road from Mpraeso to Mangkrong, Kwahu, a valuable deposit of limestone has been found. This is almost undoubtedly the southward extension along strike of similar beds of limestone discovered by the Geological Survey in the bed of the Afram River near Okraji in 1917. Analyses made of that rock showed it to be a magnesian limestone of good quality.

Analyses of the bauxite, manganese ore and limestone from these localities will be made as soon as possible.

### NIGERIA

The Director of the Imperial Institute has received from Captain R. C. Wilson, Director of the Geological Survey of Nigeria, the following report relating to geological work in Nigeria during the half-year ended June 30, 1928.

*Gold.*—Geological investigations have been continued in the Minna-Gwari belt and the mapping of the Fuka sheet, which includes the country around Minna and covers an area of about 1,200 square miles, is now complete, and the reconnaissance of the adjoining sheet is proceeding. Schists of both arenaceous and argillaceous types are the oldest rocks in the area and they have been extensively intruded by orthogneisses of different kinds. Pegmatite dykes, quartz veins and stringers abound, and traverse both sets of rocks extensively in all directions. In the past practically all the gold that has been won has been alluvial, and it has been recovered from the rocky stream beds by panning. In one or two places only has gold been found in situ in quartz veins and there can be no doubt that these are the original source of the gold. Along some of the rivers there are extensive gravel terraces, but so far the values obtained from them are somewhat disappointing.

*Coal.*—The work of mapping the coalfield has been continued to the north of the Udi-Onitsha road in the neighbourhood of Nsukka. The country has not been so deeply incised as that further to the south and natural sections are consequently less abundant. Coal seams have been located along the escarpment and are known to occur

some miles to the west, the intervening country being obscured by the Benin Sands through which hills of the older rocks project here and there. It is probable that these coals in the west belong to the Cretaceous group, but this has not yet been definitely settled.

*Oil.*—A further small seepage of crude oil has been discovered in the escarpment running east and west towards Afikpo. A preliminary examination of the locality was commenced, but was greatly hampered by the early rains and has consequently been discontinued till next dry season. The seepage occurs near the base of the Pebbly Sandstone Group at its junction with the underlying Cretaceous shales. It amounts to about two gallons daily, but at present it is not certain whether the oil is being derived from the sandstone or rising through the shales. A sample is being examined at the Imperial Institute.

*Water Supply.*—Investigations to determine the possibility of obtaining sub-surface supplies of water have been commenced in Sokoto Province, where there are a number of areas that are waterless and uninhabited. These lie entirely within the area of sedimentary rocks and the evidence so far obtained suggests that, while the geological conditions are generally unfavourable for the presence of artesian water, good supplies, ample for domestic purposes, will be obtainable by sinking wells to moderate depths. A trial well put down by the Survey encountered a good flow of water under slight pressure at 115 ft. Two distinct groups of rocks have now been recognised, but their mutual relationship and relative ages are so far somewhat uncertain. One of these groups is fossiliferous and collections are being brought home for detailed examination and determination.

### SIERRA LEONE

The Director of the Imperial Institute has received from Major N. R. Junner, Director of the Geological Survey of Sierra Leone, the following report on work carried out by him during the half-year ended June 30, 1928.

*Gold.*—In April 1926, a very good prospect of alluvial gold was obtained from a stream at Masombiri, Southern Koinadugu District, Northern Province.

During the early part of the present year further work was carried out in this area and alluvial gold was found to be widely distributed. The gold is associated with a belt of schists, 3 to 10 miles wide and at least 30 miles long.

The rocks are banded ironstones, argillaceous and

arenaceous schists, quartz conglomerate, and talc-, chlorite- and hornblende-schists. These rocks are intruded by tourmaline-, biotite- and muscovite-granites and are traversed by numerous quartz reefs and some pegmatite veins.

The banded ironstones consist of varying proportions of magnetite and hæmatite, quartz and a green iron silicate resembling chamosite. In places they pass into deposits of hæmatite containing over 65 per cent. of iron and less than 1 per cent. of silica.

The most promising prospects of alluvial gold were obtained from the Pampana River, the Makawke River and its tributaries and the Tebengko River.

*Titanium Ores.*—Ilmenite and titaniferous magnetite are widely distributed in the Peninsula of Sierra Leone. They occur as veins and segregations in the rocks of the norite complex and as "black sand" in beach- and river-gravels and in deposits around the foot of the hills in the same area.

Individual deposits vary greatly in composition, from nearly pure ilmenite to magnetite containing only a small quantity of titanium.

The following analyses were made at the Imperial Institute of samples from lodes in the norite near Hastings (Analysis No. 1) and Mt. Aureol, Freetown (Analyses Nos. 2a and 2b).

		(1)	(2a)	(2b)
		Per cent.	Per cent.	Per cent.
Ferric oxide	Fe <sub>2</sub> O <sub>3</sub>	25.06		
Ferrous oxide	FeO	28.02	76.92	76.36
Titanium dioxide	TiO <sub>2</sub>	42.34	15.70	7.44
Vanadium pentoxide	V <sub>2</sub> O <sub>5</sub>	0.38	0.69	n.det.
Chromic oxide	Cr <sub>2</sub> O <sub>3</sub>	nil	4.36	3.16

These samples are too high in titanium for use as iron ores, but the deposits near Hastings, and certain others rich in ilmenite, are worthy of examination as possible sources of titanium ore. Ores containing 32 per cent. to 35 per cent. of titanium dioxide are mined and used in the United States and command a price equivalent to 29s. to 33s. a ton. Canadian ilmenite containing 35 per cent. to 45 per cent. of TiO<sub>2</sub> is worth 21s. to 40s. a ton f.o.b. North Atlantic ports.

Some of the alluvial "black sand" deposits in the Peninsula of Sierra Leone contain appreciable amounts of platinum. These are probably the most promising from the commercial standpoint.

Rutile in coarse crystals and finely granular ilmenite are very abundant in the gravels of the Little Scarcies

River a short distance below the confluence with the Mabole River (Northern Province of the Protectorate).

### UGANDA

In a communication to the Director of the Imperial Institute, the Director of the Geological Survey of Uganda gives an account of the investigations carried out by the officers of that Department during the half-year ended June 30, 1928.

In the Sango Bay area (S.E. Koki), the Director (Mr. E. J. Wayland) investigated the high-level beaches of Lake Victoria in order to ascertain the former lake-level at the time when the alluvial tin was washed out of the Ankole valleys, and thus to locate the most likely place for their re-deposition. A number of high-level beaches were found. A very constant one exists at 175 ft. above the present lake, and another at nearly 300 ft. The work is not yet completed; but the indications are that the 300 ft. level represents a pluvial rise, and it is possible that tin-bearing placers may be found near the point where the Kagera crosses over from Uganda to Tanganyika Territory at parallel  $1^{\circ}$  S.

The Director examined the relationship between the Bukoba Sandstones and the Karagwe-Ankolian rocks in the Sango Bay area, and discovered an unconformable junction, which proves the correctness of Mr. Combe's view that the Bukoba Sandstones are the younger of the two.

In the Eastern Province, he examined the Soroti-Lango area in order to advise with regard to improving dry-season water supplies. At Karamoja, he sought for a new route from the populated parts of the Soroti district to Moroto, to replace the present waterless route. He succeeded in finding a shorter route along which water can be obtained.

He accompanied the Anglo-Persian Oil Company's geologist on a tour of inspection of the N.E. shores of Lake Albert where several more presumed domes were found, and further collections of fossils were made from the Bone Beds.

In the Subukia Valley, Kenya Colony, Mr. W. C. Simmons made enquiries into the geological effects of the earthquake of January 6, 1928, mapping the newly-produced faults and giving advice regarding the establishment of seismological stations in Kenya.

Mr. A. D. Combe made a geological map of part of the Kavirondo (Kenya) area. The country consists largely

of Karagwe-Ankolian rocks intruded by granites and dolerites. No economic minerals were discovered and it does not seem very likely that any minerals of value will be found within the area examined. Mr. Combe also carried out general investigations and mapping in the Rufumbira and Ankole tin areas. A memoir on these areas is in course of production.

Mr. T. Hirst made geological observations in the volcanic areas of Walasi Hill and Mt. Elgon. He obtained some interesting results bearing on the volcanic history of the area, indicating that the outbursts of Elgon may possibly be Cretaceous.

In the Lukonge-Busoba area, he investigated the nature and economic possibilities of the area, mapping fossiliferous sedimentary series of probably Karroo age. No indications of coal were found, but gold was found just outside the sedimentary area.

In the Bugiri-Bulugwe area, Mr. Hirst found a large development of Karroo strata, and it appears that certain banded ironstones belong to this series. This is important because it suggests that the Bukoba Sandstone Series is Karroo, as originally suggested. A preliminary map was made of the area.

At Entebbe, Mr. S. Gill carried on the work of trial boring into the Karroo. This bore is put down near what is believed to be the middle of the basin. Its object is to test the whole sequence of the Entebbe beds, which do not crop out anywhere in the Peninsula. A depth of 938 ft. was reached, but the beds were not bottomed. Some of the beds are petroliferous, but no thick seams of coal have yet been struck.

In connection with the Survey Laboratory work, Mr. Simmons reports that during the period under review, 122 samples of rocks and minerals were examined for Government Departments and prospectors. These included ores of gold, silver and tin, and specimens of copper ore (malachite, etc.) from Kilembe. Borehole samples of crushed rock from Entebbe were examined. Much of the work done related to the petrology of field specimens, and the results of this work will later be incorporated in the official reports of the work of the Survey. The laboratory buildings at headquarters are being extended to cope with the increasing work. It is noted that at present much interest is being taken in the mineral possibilities of Uganda, and several well-qualified prospecting parties are in the field.

## ABSTRACTS OF RECENTLY PUBLISHED LITERATURE ON AGRICULTURE AND FORESTRY

*In this section a summary is given of the contents of some of the more important recently published papers and reports relating to tropical agriculture and forestry. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.*

### AGRICULTURE

#### OILS AND OIL SEEDS

**Candlenuts.**—Experimental cultivation of the candle-nut tree (*Aleurites triloba* = *A. moluccana*), known locally in Malaya as "Buah keras," has been carried out at the Government Experimental Plantation, Serdang, during the last six years (*Malayan Agric. Journ.*, 1928, 16, 212). A block of  $8\frac{1}{4}$  acres was planted in March 1922, the seeds having been obtained from Upper Perak. These were sown one foot apart each way in nursery beds and over 75 per cent. germinated, the average period of germination being six weeks. In November 1922 the young plants were transplanted in the field at distances of 20 ft. by 20 ft., equivalent to 108 trees per acre. Subsequent observations showed this planting distance to approximate to the optimum for conditions prevailing at Serdang. The plants reached a height of 6 ft. six months after planting. About 15 per cent. of the young plants died and were replaced. In July 1923 the whole area planted was silt-pitted to prevent soil erosion, to conserve moisture and at the same time to allow better aeration of the soil. In April 1924 the trees commenced to flower, but it was not until a year later that any fruits reached maturity, when harvesting of the nuts was started. Although fruits are produced during almost every month of the year, the heaviest yield is given in July and August. The returns obtained in the fourth and fifth years after planting were 1,519 lb. and 3,732 lb. of nuts respectively, corresponding to average yields per acre of 184 lb. and 403 lb. These yields are much lower than those obtained in the Philippine Islands and are insufficient to make the cultivation of the crop profitable. It is pointed out, however, that possibly the maximum yield of nuts has not yet been reached.

On account of the softness and brittleness of the wood, candlenut trees should be grown in a sheltered position to avoid damage by storm. In November 1925 the trees were found to be attacked by a fungus of *Diplodia* species. The disease spread rapidly and a few trees were killed.

Spraying with Bordeaux mixture checked the growth of the fungus, but the disease is still in evidence on many trees and has to be constantly dealt with. It is considered that this fungus probably is largely the cause of the low yields obtained at Serdang. Samples of the nuts grown at Serdang have been examined at the Imperial Institute and found to give a normal yield of oil from the kernels.

**Coconuts.**—The area planted with coconuts in 1927 was estimated to be 168,000 acres in the Federated Malay States and 500,000 acres in the whole Malay Peninsula. The average price for copra has gradually fallen during the last four years, being, in 1927, 11.17 dollars per pikul of 133½ lb. (*Ann. Rep. Dept. Agric., S.S. and F.M.S., 1927, p. 5*). The amount of copra exported from the Federated Malay States in 1927 was 57,536 tons, valued at 10,142,826 dollars, as compared with 65,829 tons valued at 12,851,770 dollars, in the previous year. The corresponding figures for British Malaya were 86,649 tons, valued at 16,562,493 dollars in 1927 and 104,653 tons, valued at 21,852,330 dollars in 1926. It is considered probable that the drought in 1926 accounts for the lower yields in 1927. The copra content of the nuts is also stated to have been low. No great expansion of the copra industry in Malaya is to be expected owing to the difficulty of finding additional large areas of suitable land. A comprehensive series of manurial experiments is being made at the Coconut Selection Station, Klang, while experiments in methods of cultivation and the use of cover and catch crops have also been commenced. The reputed inferiority of Straits copra as compared with Ceylon and Malabar is being made the subject of chemical investigations. Climatic conditions are considered not to be wholly responsible. Work in progress comprises a study of local methods of preparing copra, together with analyses of samples of fresh and stored copra, in order to determine the range of variation in the oil content of the Straits product. As regards diseases and pests, further work in *Phytophthora* bud-rot is contemplated. A few fresh cases of salmon pink disease occurred in the coastal areas, but no large area was affected in any one place. Examination of the soil from infected areas has not led to the correlation of any particular soil factors with the incidence of this disease, although on coastal estates it is usually most active in land difficult to drain.

**Oil-Palm.**—There are now 24 oil-palm estates in the Federated Malay States. The total area under this crop

in Malaya is 18,321 acres, of which 1,516 acres are in Perak, 11,075 in Selangor, 600 in Negri Sembilan and 5,130 in Johore (*Ann. Rep. Dept. Agric., S.S. and F.M.S., 1927, p. 7*). The yield of palm oil and kernels in Malaya in 1927 was 915 tons and 185 tons respectively. These figures show a small increase over those for the previous year. A considerable increase in total crop is anticipated in 1928 as new areas will come into bearing. There are now four up-to-date extraction plants on Malayan estates. It is satisfactory to note that Malayan palm oil realised prices in advance of the African product. A preliminary survey of the various types of oil-palm growing at the Experimental Plantation, Serdang, has indicated that the range of variation in this crop is sufficient to render profitable the selection of the best type of palm for plantation purposes. On the whole oil-palms were fairly free from any serious diseases or pests during 1927. Crown disease gave some trouble on areas of young palms and a few cases of bud-rot were reported.

The manufacture of palm oil as practised in Sumatra is described in *Med. Alg. Proef. A.V.R.O.S. (Algemeene Ser., No. 33, 1928)* by H. N. Blommendaal. A brief survey of the history of the preparation of palm oil is given. The initial planting of the oil-palm in Sumatra took place in 1914, and in 1926 the area devoted to the crop was 27,141 hectares (of which 9,318 hectares were producing), exclusive of the plantations of the Handelsvereniging Amsterdam. In 1926, 11,714 tons of palm oil and 2,061 tons of kernels were exported. The maximum oil content of the bunches is reached when several outer fruits loosen naturally from the bunch, and collection is therefore limited to such bunches. The bunches are transported by narrow-gauge railways to the factories where they are sterilised by being heated in vertical or horizontal autoclaves with live steam under pressure. Sterilisation not only ensures an oil of low acidity by inhibiting hydrolysis through enzyme action but has other technical advantages, such as increased output and easier purification. The kernels are loosened from the shells by the heating process, thereby facilitating cracking and rendering separation more complete. After sterilisation the fruits are separated from the bunches in thrashing machines, and small pieces of vegetable debris are eliminated by sieving and winnowing. The oil can be obtained from the separated fruits by six different methods, viz., expression, centrifuging, or solvent extraction of the whole fruits or of the pulp alone. The usual method employed on the



East Coast of Sumatra is to mash the whole fruits and submit the resulting mass to expression. The fruits are mashed in steam-jacketed kettles fitted with stirring arms, whereby the pulp is loosened from the nuts. Pressing of the mashed fruits is usually effected in hydraulic presses fitted with two revolving cages so that one is being discharged and filled while the fruits in the other are being pressed, 85 to 90 per cent. of the available oil being thus obtained. Anderson expellers have been tried but up to the present this type of press has not given entirely satisfactory results. The residue from the hydraulic presses still contains about 20 per cent. of oil, calculated on the dry pulp. The nuts from this residue are separated in octagonal rotary screens, through the perforated sides of which the pulp falls. This separated pulp is sometimes discarded and sometimes pressed a second time. Recently extraction of it with solvents has been introduced. The usual method of purifying the crude oil is to heat it with live steam which causes any sediment to fall and the water present to form a layer at the bottom of the settling tank. Centrifugal separators and filter presses are also used.

The nuts after separation from the pulp in the rotary screens have to be dried before being cracked. If centrifugal cracking machines are used the moisture content of the kernels must be reduced to about 15 per cent., while in the case of cracking machines of the roller type, the moisture content of the kernels should not be greater than 10 to 12 per cent. Kernels insufficiently dried cause difficulties in the cracking by either type of machine. Nuts from the screens still have a small tuft of fibre adhering at the place where the fruit was originally joined to the bunch. The removal of this fibrous tuft and the drying of the nuts are accomplished by heating the nuts with hot air or exhaust gases at 150° C. in rotary horizontal drums. On rotating the drums the nuts rub against one another and thereby the tufts are removed. The greater number of the cracking machines are of the centrifugal type. It is recommended that the nuts should first be graded into three sizes and a separate cracking machine, suitably adjusted, detailed for each grade. This process is conducive to greater efficiency in the cracking. After being cracked, the mixture of broken shell, kernels and unbroken nuts is passed to a sorting screen which has at one end a mesh through which small pieces of shell fall and at the other end holes which allow kernels and larger pieces of shell to pass. Uncracked nuts and very large pieces of shell pass over both sizes of mesh and are returned to the

cracker. The kernels are finally separated from shell by means of a clay suspension of specific gravity 1.2. Another method separates kernels from shell by an intermittent flow of water. Separation by dry methods has not yet proved satisfactory. After being rinsed free from clay the kernels are dried either in the sun or by artificial heat to a moisture content of from 5 to 6 per cent.

The methods of packing the oil are discussed. The most common method is the use of barrels holding 40 gallons, made of firwood or oak. By careful cooperage the loss through leakage can be reduced to less than 2 per cent. Shipping in bulk has recently been introduced. In some cases the oil is railed to the docks in tanks holding  $4\frac{1}{2}$  tons, which are emptied into the ship's deep tanks. As regards the marketing of palm oil, sellers usually receive an allowance for low free fatty acid content, whilst stipulations are also made for impurities and moisture. It is claimed that palm oil with a maximum acidity of 4 per cent. on arrival in Europe and free from impurities can easily be guaranteed. The article includes descriptions of plant for sterilising, meshing, pressing hydraulically, solvent extraction and nut cracking, and is illustrated with 25 plates.

## FIBRES

### *Paper-making Materials*

*Pinus insignis*.—An interesting report on "Kraft Pulp and Paper from *Pinus insignis*," by L. R. Benjamin, J. L. Somerville, R. B. Jeffreys and W. E. Cohen, has been issued as *Bulletin No. 35* (1928) of the Council for Scientific and Industrial Research, Commonwealth of Australia. There is a market already existing in Australia for at least 15,000 tons of kraft pulp annually, but the relatively slow growth of the manufacture of such pulp in the Commonwealth is largely due to the lack of a suitable and sufficiently abundant indigenous raw material. Some years ago an attempt was made to establish a kraft pulp mill in Queensland, using saw-mill waste from "hoop pine" (*Araucaria Cunninghamii*), but the conditions were too unfavourable and the scale of operations too small for the venture to be successful.

It became evident that in order to develop a kraft pulp industry in Australia it would be necessary to utilise exotic conifers, and particular attention has therefore been devoted to *Pinus insignis* (the Remarkable or Monterey pine), which has been planted over large areas, especially in South Australia. Investigations on the manufacture of kraft or sulphate pulp have been carried out by the

Commonwealth Development and Migration Commission and the Council of Scientific and Industrial Research, with the co-operation of Australian Paper Manufacturers Ltd.

A description of the methods used in the various trials is given and the results are recorded. Preliminary laboratory tests showed that the best results were to be expected by means of the sulphate process, the wood being digested with about 21 per cent. of alkali under 100 lb. pressure. Trials which were made on a semi-commercial scale proved that, on the average, a yield of oven-dry pulp amounting to about 50 per cent. of the oven-dry wood could be obtained of a quality practically equal to that of the pulp now imported into Australia for the manufacture of kraft paper.

Having established this point, consideration was next directed to the question as to whether the manufacture of the pulp would be commercially feasible in South Australia under existing conditions. The various costs of conversion are estimated, including those of the chemicals, labour and supervision, steam, power, screens, plates, felts, wires, lubricants and sundry stores, and amount to £6 17s. 3d. per ton. The cost of establishing a mill to make 20 tons of pulp per day is estimated at £80,000, exclusive of working capital. Probably £100,000 would be necessary to finance the scheme. Allowing depreciation at 10 per cent. and allowing 2½ per cent. for taxes and insurance on £80,000, the cost per ton of pulp would be £1 13s. 6d. The carriage of the moist (50 per cent.) pulp to the nearest port and thence by sea to Melbourne would cost £2 12s. 6d. per ton of the air-dry pulp (containing 10 per cent. of moisture). To these figures, amounting in all to £11 3s. 3d., must be added the cost of 2½ cords of stacked wood at 12s. per cord, £1 10s., and that of cutting and transporting 2½ cords of wood, also £1 10s., making a total cost of £14 3s. 3d. per ton. A 10 per cent. profit on the capital of £10,000 (£1 13s. 6d. per ton of pulp) would make the lowest possible c.i.f. selling price £15 16s. 9d., as compared with the existing c.i.f. price of £12 8s.

It is anticipated that in 10 or 12 years the quantity of *Pinus insignis* timber available in South Australia will be sufficient to justify the erection of a mill with a capacity of 60 tons of pulp per day. In such a mill, costs would naturally be lower than in the mill of 20 tons per day on which the above estimates were based, and it is probable that they could be reduced to the existing c.i.f. price of pulp.

It is therefore concluded that, as soon as operations on a large scale are possible, the production of kraft pulp and the manufacture of kraft paper could be carried on con-

jointly in South Australia with greater economy than is possible in either branch of the industry under the conditions at present prevailing.

Specimens of kraft paper manufactured from *Pinus insignis* wood are bound up with the report.

[Reference to the strength of Australian-grown *Insignis* pine timber will be found on p. 494 of this BULLETIN.]

**Mangrove Wood.**—Samples of the wood of three species of mangrove from Madagascar, viz. *Rhizophora mucronata* (Honkolahy), *Bruguiera gymnorhiza* (Tsilolona) and *Ceriops Boiviniana* (Honkovavy), have been investigated by L. Vidal and M. Aribert with a view to determining their suitability for paper-making, and the results have been published in *L'Agronomie Coloniale* (1928, 17, 203).

The three woods respectively have a density of 0.94, 0.95 and 1.03, and a cellulose content of 48.2, 46.0 and 45.0 per cent.; on extraction with a mixture of alcohol and ether they yielded 4.5, 2.9 and 4.9 per cent. of extractive, containing colouring matter, waxes, etc.

On treatment with 25 per cent. of caustic soda of a concentration of 18° Baumé (at 15°) for eight hours under a pressure of 5 kilos. the wood of *Rhizophora mucronata* furnished 47 per cent. of pulp (expressed on the moisture-free wood). The pulp proved very difficult to bleach, the yield of bleached pulp being 42 per cent. The wood of *Bruguiera gymnorhiza* when treated by the same process gave 46 per cent. of pulp which was extremely difficult to bleach, the yield of bleached pulp in this case being 39 per cent. The wood of *Ceriops Boiviniana* gave 47.5 per cent. of pulp which was even more difficult to bleach.

The microscopical characters of the three pulps are described, and an account is given of experiments to manufacture paper from them. In general, for satisfactory pulping the mangrove woods demand severe treatment which would be so expensive as to be prohibitive, and the papers which they furnish are very weak. The manufacture of bleached pulp would therefore be impracticable. It is considered, however, that it might be possible to prepare a coarse, unbleached pulp specially designed for wrapping-paper, but the results so far obtained are not conclusive. In any case, owing to the weakness of the material it could not be converted into papers at all comparable to kraft and Manila papers.

## RESINS

**Lac.**—The Indian Lac Association for Research has recently issued the *Reports* of the Committee and of the

Director, Indian Lac Research Institute, Nankum, Ranchi, for the year ending March 31, 1928. From the Committee's report it would appear that the rapid progress in the manufacture of cellulose lacquers and other shellac substitutes in England and America is viewed in India with some alarm. As a result of negotiations between the Indian Lac Association and the United States Shellac Importers' Association, the Shellac Research Bureau has been formed to carry out research work on shellac at the Polytechnic Institute, New York, to which the Indian Lac Association have contributed \$2,500. The view taken by the Indian Lac Association with regard to competition from lac substitutes was expressed by the Chairman, Mr. J. D. Marshall, when he stated that his investigations in England in December 1927 had convinced him that synthetic substitutes were making very rapid headway, particularly in the paint and varnish trades, and that it was only the phenomenal demand for gramophone records which was making deliveries appear so good.

A large amount of valuable work has been carried out at the Lac Research Institute at Nankum during the year under review, particularly in the Entomological Section, where many insects, either hostile or friendly to the lac insect, have been identified and studied in considerable detail. Pests attacking the host trees are also described and control measures are indicated.

## FORESTRY AND TIMBERS

**Strength of Australian-grown *Insignis* Pine.**—The success which is attending the planting of *Pinus insignis* Douglas (*P. radiata* D. Don) in Australasia for the production of timber for structural purposes is well known and it is significant that the timber now figures to an appreciable extent in the returns of sawn timber produced in New Zealand. This Californian tree was considered by E. H. Wilson in the report (1923) of his tour through the southern hemisphere (see this BULLETIN, 1923, 21, 632) as likely to prove the most valuable northern conifer for planting in southern countries. While the silvicultural aspect of the question appears to be entirely satisfactory, doubts have been expressed as to the technical value of the timber for constructional purposes, "*Insignis* pine" being usually regarded as a timber lacking strength. This opinion is based on the character of the timber of trees grown in their native country, such wood being stated to be light, soft, not strong, and brittle. Strength tests of the timber grown in the South of Australia and Tasmania, however,

have shown that weakness and brittleness are not the characters of Insignis pine as grown in the Commonwealth and that there is every reason to believe that the tree is providing a timber which will prove of great value for general structural work. This view is confirmed by the results of tests carried out recently in the Sydney Technical College, and at the Experimental Station of the R.A.A.F. at Randwick by M. B. Welch and published by him in *Journal and Proceedings of the Royal Society of New South Wales* (1927, 61, 354). Timber obtained from Gosford and Sutton Forest (New South Wales), from Creswick (Victoria), and from Wirrabara and Mount Gambier (Southern Australia) was supplied by the Forestry Commissioner of New South Wales and employed for tests on air-dry specimens, using a 25-ton Riehlé machine. The tests showed that some variation in density and strength occurs in the timber grown under the different conditions obtaining in the districts mentioned, but even the lightest and most rapidly grown material possesses considerable strength and, where more slowly grown, may possess remarkable toughness. Apart from the wood near the heart there is no justification for the statement that the timber is brittle. The investigations were concerned also with the microscopic structure of the timber; the characters observed place the wood among those belonging to the American yellow or pitch pine group.

**Honduras Pine Forests.**—In *Tropical Woods*, No. 10 (June 1, 1927), W. D. Durland describes the occurrence of pine in Honduras. The pine area of Honduras is a portion of a forest extending from British Honduras through Guatemala into Nicaragua and is found in the so-called temperate zone which extends behind the hot lowlands from an altitude of 1,500 ft. to about 5,700 ft. In this region pine is the chief tree species; in the lower elevations it occurs in mixture with hardwoods and gradually emerges into practically pure stands as the higher lands are reached. The tree chiefly concerned is *Pinus caribæa* Morelet, the "Cuban pine" of Southern Florida. Two varieties are recognised, viz. "pino ocote," occurring below 2,500 ft., and "pino veta," which generally speaking is found in the higher districts. Both varieties are rich in resin. The trees vary in size; at the lower elevations the trees average 14 to 18 in. in diameter and yield one or two 16 ft. logs, while higher up the diameters vary between 30 and 34 in. with three or more 16 ft. logs per tree. Timber shipped to American merchants from Nicaragua was reported to have the general properties of southern long

leaf pine ("pitch pine") and was found to be of satisfactory quality and readily saleable.

Short accounts of other Coniferæ occurring in Honduras are included in a valuable article by S. J. Record on the trees of Honduras in the same issue of *Tropical Woods*. *Pinus oöcarpa* Schiede ("ocote," "pino blanco") is a medium-sized or large tree with a pale yellowish, somewhat light and soft timber, not highly resinous. *P. Pseudostrobus* Lindl. has also been collected. A fir tree (*Abies religiosa* (H.B.K.) Schl. and Cham.), known as "pino," grows in the high mountains and yields a brownish, light, moderately hard wood, fine-textured and non-resinous. The "ciprés" is *Cupressus Bentharii* Endl., whose soft, fragrant wood resembles that of the red or pencil cedar (*Juniperus virginiana* L.), being light, of fine texture and durable.

**Timber Seasoning in Australia.**—In a publication recently issued by the Munitions Supply Board Department of Defence, Australia, entitled "Notes on the Seasoning of Timber," J. T. McCormick and R. E. Summers deal with the special problems encountered in Australia, owing to the climate and the refractory nature of many of the native timbers in supplying sound, well-seasoned hardwood. The high temperatures and very low relative humidities experienced under normal conditions promote too rapid drying with its attendant deterioratory effects on timber and thus render air-seasoning unsuitable, unless the timber is stacked under shelter and the humidity of the surrounding air raised by restricting the ventilation.

A great tendency to check is found in many of the eucalypts, from which genus most of the Australian hardwoods are derived; in some cases, checking will occur at air temperatures if the wood is exposed to relative humidities as high as 85 per cent.

The desirability of seasoning these hardwoods by means of controlled temperatures and humidities is apparent, and a large amount of laboratory work and semi-commercial scale seasoning has been carried out in the laboratories of the Munition Supply Board, results of which are recorded in this paper.

## BIBLIOGRAPHY

*Comprising the more important reports, articles, etc., on plant and animal products contained in publications received in the Library of the Imperial Institute during the three months August–October 1928.*

*The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.*

## AGRICULTURE

*General*

Report on the Work of the Research and Education Division of the Ministry of Agriculture and Fisheries for the Year 1926–27. Pp. 87, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 2s. 6d.

The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, for the Year 1926–27. Pp. 222, 9½ × 6. (Bath: University of Bristol, 1927.)

Report on the Prices and Supplies of Agricultural Produce and Requirements in England and Wales, 1927–28. *Agric. Statistics, Ministry of Agriculture and Fisheries*, 1927, vol. lxii, Part II. Pp. 132, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 1s. 3d.

The Agricultural Output of Scotland, 1925. Pp. 94, 9½ × 6. (Edinburgh: H.M. Stationery Office, 1928.) Price 2s.

Annual Report of the Director of Agriculture, Cyprus, for the Year 1927. Pp. 28, 9½ × 6. (Nicosia: Government Printing Office, 1928.)

Administration Report of the Director of Agriculture, Ceylon, for 1927. Pp. 33, 13 × 8½. (Colombo: Government Printer, Ceylon.) Price 75 cents.

Technical Reports of the Department of Agriculture, Ceylon, for the Year 1927. Pp. 82, 9½ × 6½. (Colombo: Government Printer, 1928.)

Reports of Divisional Agricultural Officers, Department of Agriculture, Ceylon, for the Year 1927. Pp. 22, 9½ × 6. (Colombo: Government Printer, 1928.)

Agricultural Statistics of India, 1925–26. Vol. II (Indian States). Pp. 87, 13½ × 8½. (Calcutta: Government of India Central Publication Branch, 1928.) Price Re.1, annas 4, or 2s. 3d.

Royal Commission on Agriculture in India. Vol. I, Part III. Evidence of Officers Serving under the Government of India and of Witnesses from Minor Provinces. Pp. 152, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 1s. 9d.

Royal Commission on Agriculture in India. Vol. XI. Evidence taken in Sind. Pp. 324, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 3s. 9d.

Royal Commission on Agriculture in India. Vol. XIV. Appendix to the Report. Pp. 432, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 7s. 9d.

Annual Report of the Department of Agriculture, Assam, for the Year 1927–28. Pp. 42, 9½ × 6½. (Shillong: Government Press, 1928.) Price Re.1.1, or 1s. 7d.

Agricultural Statistics of Bihar and Orissa for 1926–27. *Dept. Agric., Bihar and Orissa*. Pp. 41, 13 × 8½. (Patna: Superintendent, Government Printing, 1928.) Price Rs. 2–4.



Report on the Working of the Department of Agriculture of the Central Provinces for the Year 1926-27. Pp. 55,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Nagpur: Government Press, 1928.) Price Rs. 1-7-0.

Annual Report of the Taliparamba Experiment Station and the Agricultural Middle School Farm, Madras, for 1927-28. By M. Govinda Kidavu. Pp. 20,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

Report on the Work of the Central Experiment Station, Coimbatore, Madras, for 1927-28. Pp. 47,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

Annual Report of the Guntur Experiment Station, Madras, for the Year 1927-28. By A. V. Tirumuranatham Pillai. Pp. 22,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

Report of the Hagari Experiment Station, Madras, for the Year 1927-28. By P. H. Rama Reddi. Pp. 24,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

Report of the Work of the Nandyal Experiment Station, Madras, for 1927-28. By P. H. Rama Reddi. Pp. 14,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

Annual Report of the Palur Experiment Station, Madras, for the Year 1927-28. By D. Ananda Rao. Pp. 42,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

Annual Report of the Samalkota Experiment Station, Madras, for the Year 1927-28. By G. Jogiraju and R. N. K. Sundram. Pp. 24,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

Administration Report of the Agricultural Department, Mysore, for 1926-27. Pp. 119,  $13 \times 8$ .

The Crops of Sind: their Geography and Statistics. By G. R. Ambekar. *Bull. No. 150 of 1927, Dept. Agric., Bombay*. Pp. 158,  $9\frac{1}{2} \times 6$ . (Bombay: Government Central Press, 1928.) Price Rs. 2, An. 1, or 4s.

Annual Report on the Department of Agriculture, S.S. and F.M.S., for the Year 1927. Pp. 18,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Kuala Lumpur: F.M.S. Government Press, 1928.)

Annual Reports for 1927 of Heads of Divisions, Department of Agriculture, Federated Malay States and Strait Settlements. *Malayan Agric. Journ.* (1928, 16, 92-179).

Year-Book, Department of Agriculture, Gold Coast, for 1927. Pp. 160,  $10 \times 6$ . Issued by the Director of Agriculture, Gold Coast.

Agricultural Survey in Connection with the proposed Northern Territories Railway. By G. C. Coull. *Year-book, Dept. Agric., Gold Coast*, 1927, pp. 37-44.

Annual Report of the Department of Agriculture, Kenya, 1927. Pp. 311,  $9\frac{1}{2} \times 6$ . (Nairobi: Government Press, 1928.) Price 5s.

Annual Report on the Agricultural Department, Nigeria, for the Year 1927. Pp. 13,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Lagos: Government Printer, 1927.)

Report of the Secretary, Department of Agriculture, Southern Rhodesia, for the Year 1927. Pp. 50,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Salisbury: Government Printer, 1928.)

Annual Report of the Department of Agriculture, Uganda Protectorate, for the Year ended 31st December, 1927. Pp. 51,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (Entebbe: Government Printer, 1928.) Price Shs. 4/50.

Annual Report on the Agricultural Department, Zanzibar Protectorate, for the Year 1927. Pp. 25,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Zanzibar: Government Printer, 1928.)

Annual Report of the Department of Agriculture of the Province of Alberta for the Year 1927. Pp. 161,  $10 \times 6\frac{1}{2}$ . *Sessional Paper No. 2*. (Edmonton: Acting King's Printer, 1928.)

Agricultural Statistics, British Columbia, 1927. *Bull. No. 104*,

*Dept. Agric., (Statistics Branch), British Columbia.* Pp. 43, 10 × 6½. (Victoria, B.C.: King's Printer, 1928.)

Report of Department of Agriculture, Barbados, 1926-1927. *Supplement to Official Gazette*, 20th Sept. 1928. Pp. 83, 14 × 8½.

Report of the Department of Agriculture, Bermuda, for the Year 1927. Pp. 52, 13 × 8. (Hamilton, Bermuda: Bermuda Press, Ltd., 1927.)

Report on Agricultural Department, St. Lucia, 1927. Pp. 31, 13 × 8. (Castries, St. Lucia: Government Printing Office, 1928.) Price 6d.

Report on the Agricultural Department, St. Vincent, for the Year 1927. Pp. 29, 13 × 8. (Trinidad: Imperial Commissioner of Agriculture for the West Indies, 1928.) Price 6d.

Report of the Advisory Council of Science and Industry of South Australia, No. 9, 1927. Pp. 28, 13½ × 8½.

Jahresbericht für die Zeit vom 1. Januar bis 31. Dezember 1927, Institut für angewandte Botanik, Hamburgische Botanische Staatsinstitute. Pp. 125, 9½ × 7. (Hamburg: 1928.)

Annuario del R. Istituto Sperimentale Agrario in Sidi Mesri, 1928. Pp. 253, 9½ × 6½. (Tripoli: Governo della Tripolitania, Direzione dell'Agricoltura, 1928.)

I Servizi Agrari in Triopolitania. Pp. 35, 9½ × 6½. (Tripoli: Governo della Tripolitania, Direzione dell'Agricoltura, 1928.)

Jaarboek van het Departement van Landbouw, Nijverheid en Handel in Nederlandsch-Indië, 1927. Pp. 272, 9½ × 6½. (Wetevreden: Landsdrukkerij, 1927.) Price fl. 3.25.

Annual Report of the Acting Director of the General Experimental Station of the A.V.R.O.S., 1st July 1927-30th June 1928. *Communic. of the Gen. Exper. Sta. A.V.R.O.S., Gen. Ser. No. 34.* Pp. 41, 10½ × 7½. (Medan: Varekamp & Co., 1928.)

Verslag, Departement Landbouwproefstation in Suriname, 1924-1927. Pp. 37, 9 × 6. (Paramaribo: J. F. Oliviera, 1928.)

Yearbook of the United States Department of Agriculture for 1927. Pp. 1234, 9 × 6. (Washington: Government Printing Office, 1928.) Price \$ 1.50.

Forty-Third Annual Report of the Maine Agricultural Experiment Station, 1927. Pp. 331, 9 × 6. (Orono, Maine: University of Maine, 1928.)

Forty-Sixth Annual Report of the Ohio Agricultural Experiment Station, for 1926-27. *Bull. 417, Agric. Exper. Sta., Ohio.* Pp. 118, 9 × 6. (Wooster, Ohio: Experiment Station, 1928.)

Field Crops for Pump Irrigation at Harney Branch Experiment Station, 1920 to 1927. *Sta. Bull. 236, Agric. Exper. Sta., Oregon.* Pp. 30, 9 × 6. (Corvallis: State Agricultural College, 1928.)

Report of the Guam Agricultural Experiment Station, 1926. Pp. 19, 9 × 5½. (Washington, D.C.: U.S. Government Printing Office, 1928.)

Report of the Hawaii Agricultural Experiment Station, 1927. Pp. 27, 9 × 5½. (Washington, D.C.: U.S. Government Printing Office, 1928.)

Report of the Virgin Islands Agricultural Experiment Station, 1927. Pp. 17, 9 × 5½. (Washington, D.C.: U.S. Government Printing Office, 1928.)

Annuario do Ministerio da Agricultura, Republica do Brasil, 1928. Pp. 558, 9 × 6½. (Rio de Janeiro: Serviço de Informações, 1928.)

Dixième Rapport de la Station Agronomique de la Guadeloupe, 1927-1928. Pp. 43, 9 × 8½. (Point-a-Pitre: A. & J. Lautric, 1928.) With English text.

Les Prairies de Madagascar. By Perrier de la Bathie. *Rev. Bot. App. et d'Agric. Col.* (1928, 8, 549-557; 631-642; 696-707).

**Irrigation West of the Cascades.** By L. J. Smith and H. L. Gerver. *Popular Bull. No. 140, Washington Agric. Exp. Sta.* Pp. 52, 9 × 6. (Pullman, Washington : State College, 1928.)

**The Economic Limit of Pumping for Irrigation.** By W. L. Powers. *Sta. Bull. 235, Agric. Exper. Sta., Oregon.* Pp. 48, 9 × 6. (Corvallis, Oregon : State College, 1928.)

**The Development of Water Supplies for Irrigation in Nevada by Pumping from Underground Sources.** By F. L. Bixby and G. Hardman. *Bull. No. 112, Nevada Agric. Exp. Sta.* Pp. 38, 9 × 6. (Reno, Nevada : University of Nevada, 1928.)

**Modern Field Experiments.** By T. Eden. *Trop. Agric., Ceylon* (1928, 71, 67-76).

**The Conduct of Field Experiments.** By R. O. Iliffe and B. Viswa Nath. *Bull. No. 89, Dept. Agric., Madras.* Pp. 51, 9½ × 6. (Madras : Superintendent, Government Press, 1928.) Price Re. 1 As.4.

**Plant-Breeding Methods and Results.** By F. W. Hilgendorp. *Bull. No. 5, N.Z. Dept. Sci. & Indust. Res.* Pp. 16, 9½ × 6. (Wellington, N.Z. : Government Printer, 1928.)

**Crop Rotations and Soil Management for the Prairie Provinces.** By E. S. Hopkins and S. Barnes. *Bull. No. 98, New Series, Dept. Agric., Canada.* Pp. 53, 10 × 6½. (Ottawa : King's Printer, 1928.)

**Longevity of Crop Seeds.** By K. M. Sonavne. *Agric. Journ., India* (1928, 23, 271-276).

**Weeds of Arable Land. V.** By H. C. Long. *Journ. Ministry Agric.* (1928, 35, 443-451).

**The Practical Applications of Meteorology to Agriculture.** *Journ. Ministry Agric.* (1928, 35, 618-626).

### The Soil

**The Soils of Prince Edward Island, their Nature and Composition, with Suggestions as to Fertilizer Treatment.** By F. T. Shutt. *Bull. No. 100, New Series, Dept. Agric., Canada.* Pp. 20, 10 × 6½. (Ottawa : King's Printer, 1928.)

**Notes sur la constitution et la valeur culturale des terres de diverses formations de Madagascar.** By M. Bonnefoy. *Actes and Comptes-Rendus de l'Association Colonies-Sciences* (1928, 4, 161, 170 ; 185-199 ; cont.).

**Alkali Soil Studies and Methods of Reclamation.** By P. S. Burgess. *Bull. No. 123, Arizona Agric. Exp. Sta.* Pp. 181, 9 × 6. (Tucson, Arizona : University of Arizona, 1928.)

**Reclamation of the Fresno Type of Black-Alkali Soil.** By W. P. Kelly and E. E. Thomas. *Bull. 455, Agric. Exper. Sta., California.* Pp. 37, 9 × 6. (Berkeley, California : University of California, 1928.)

**Methods of Soil Sampling and Soil Analysis Recommended Provisionally for Use in West Africa.** *Year-book, Dept. Agric., Gold Coast,* 1927. Pp. 141-148.

**A Comparative Study of the Methods of Preparation of the Soil for Mechanical Analysis with a Note on the Pipette Method.** By Amar Nath Puri and Bhailal M. Amin. *Bull. No. 175, Agric. Res. Inst., Pusa.* Pp. 15, 9½ × 7½. (Calcutta : Government of India Central Publication Branch, 1928.) Price Rs.4 (5d.).

**Losses and Gains of Nitrogen in an Indian Soil studied in Relation to the Seasonal Composition of Well Waters, and the Bearings of the Results on the Alleged Deterioration of Soil Fertility.** By H. E. Annett, A. R. Padmanabha Aiyer and Ram Narayan Kayasth. *Mém. Dept. Agric., India, Chem. Series, vol. ix, No. 6.* Pp. 79, 9½ × 7½. (Calcutta : Government of India, Central Publication Branch, 1928.) Price Rs.2 (3s, 6d.).

Nitrogen Fixation and Agriculture. By R. G. Lapaley. *Journ. Dept. Agric., W. Australia* (1928, 5, 183-187).

Manures and Fertilizers, their Nature, Functions and Applications. By F. T. Shutt. *Bull. No. 92, New Series, Dept. Agric., Canada*. Pp. 64, 9½ × 6½. (Ottawa: King's Printer, 1927.)

The Manurial Problem and its Solution. *Bull. No. 90, Agric. Dept., Madras*. Pp. 30, 9½ × 6. (Madras: Superintendent, Government Press, 1928.) Price As.2.

Preparation of Leaf Compost as a Manure for the Denuded Soils of Accra. By C. H. Knowles and J. M. Dunbar. *Year-book, Dept. Agric., Gold Coast*, 1927. Pp. 138-140.

Artificial Farmyard Manure. By V. R. Greenstreet. *Malayan Agric. Journ.* (1928, 16, 194-203).

Some Relations of Green Manures to the Nitrogen of a Soil. By T. L. Lyon and B. D. Wilson. *Mem. 115, Cornell Agric. Exp. Sta.* Pp. 29, 9 × 6. (Ithaca, New York: University of Cornell, 1928.)

Overzicht van de Resultaten der Groenbemestingsproeven bij den inlandschen Landbouw op Java. By J. G. Ossewaarde. *Korte Med. No. 4, Alg. Proefsta. voor den Landbouw*. Pp. 22, 9½ × 6. (Buitenzorg: Archipel Drukkerij, 1928.)

A Method of Increasing the Manurial Value of *Mahua* Cake. By N. D. Vyas. *Bull. No. 176, Agric. Res. Inst., Pusa*. Pp. 12, 9½ × 7½. (Calcutta: Government of India Central Publication Branch, 1928.) Price As.4 (6d.).

The Composition and Manurial Value of Sugar Beet Pulp. By H. E. Woodman. *Journ. Ministry Agric.* (1928, 35, 669-673).

#### Pests—General

Grasshoppers. Departmental Recommendations for Control. By W. B. Gurney. *Agric. Gazette, New South Wales* (1928, 39, 645-652).

The Leaf-Eating Ladybird. By M. E. Temperley. *Queensland Agric. Journ.* (1928, 30, 11-16).

English-grown Pyrethrum as an Insecticide. I. By J. C. F. Fryer, F. Tattersfield and C. T. Gimmingham. Pp. 22, 10 × 7. (Cambridge: University Press, 1928.) Reprinted from the *Annals of Applied Biology*, vol. xv, No. 3, 1928.

Three Years of Dust Spraying under Missouri Conditions. *Bull. 259, Agric. Expt. Sta., Missouri*. Pp. 12, 9 × 6. (Columbia, Missouri: University of Missouri, 1928.)

#### Diseases—General

Bordeaux Mixture, its Adhesive Power under Egyptian Climatic Conditions. By R. R. Le Geyt Worsley. *Bull. No. 78, Chem. Sec., Min. Agric., Egypt*. (Cairo: Government Press, 1928.) Price P.T.5.

Bordeaux and Lime-Sulphur Sprays. Comparative Tests in Canterbury Orchard. By L. Paynter. *New Zealand Journ. Agric.* (1928, 37, 124-126).

#### Beverages

Cocoa in West Africa. By L. J. Schwarz. *No. 68, Trade Promotion Series, U.S. Dept. Com.* Pp. 44, 9 × 6. (Washington: Government Printing Office, 1928.) Price 15 cents.

Notes sur la culture du cacao dans les terres rouges de Lukolela. By V. de Bellefroid. *Bull. Agric. Congo-Belge* (1928, 19, 3-58).

Variations in the Yields of Cacao Trees at Asuansi Experiment Station. *Year-book, Dept. Agric., Gold Coast*, (1927, pp. 67-73).

Variations in the Yields of Cacao Trees at Aburi Experiment

Station, 1914-1926. *Year-book, Dept. Agric., Gold Coast* (1927, pp. 74-77).

Initial Variations between Plots used for Cacao Manurial Trials. By A. B. Culham. *Year-book, Dept. Agric., Gold Coast* (1927, pp. 78-82).

Correlation between Rainfall and Cacao Yields in the Gold Coast, with Special Reference to Effect of April Rains on the following Cacao Crop. By W. T. O. Maidment. *Year-book, Dept. Agric., Gold Coast* (1927, pp. 83-84).

Determination of the Accuracy of Certain Methods of Sampling Cacao-beans. By A. B. Culham and L. J. Scott. *Year-book, Dept. Agric., Gold Coast* (1927, pp. 45-57).

Principles underlying the Determination of Error in Cacao-sampling. By W. H. Beckett. *Year-book, Dept. Agric., Gold Coast* (1927, pp. 58-61).

Effect of Sea Water on Mould in Cacao Beans. By J. L. Scott and W. R. Hudson. *Year-book, Dept. Agric., Gold Coast* (1927, pp. 62-66).

The Relation between Diseased Cushions and the Seasonal Outbreak of "Black Pod" Disease of Cacao. By H. A. Dade. *Year-book, Dept. Agric., Gold Coast* (1927, pp. 85-88).

A Comparison of the Pathogenicity of Various Strains of *Phytophthora Faberi* Maubl., on Cacao Pods, etc., in the Gold Coast. By H. A. Dade. *Year-book, Dept. Agric., Gold Coast* (1927, pp. 89-92).

Minor Pests of Cacao. By G. S. Cotterell. *Year-book, Dept. Agric., Gold Coast* (1927, pp. 100-106).

The Red-Branded Cacao Thrips, *Heliothrips rubrocinctus* Giard. By G. S. Cotterell. *Year-book, Dept. Agric., Gold Coast* (1927, pp. 94-99).

The Story of Colombian Coffee. Part I. *Spice Mill* (1928, 51, 1151-1156; 1350-1362; 1547-1557).

Effect of Topping on Yield of Coffee in Porto Rico. By T. B. McClelland. *Bull. No. 32, Porto Rico Agric. Exper. Sta.* Pp. 8, 9 x 6. (Washington: Government Printing Office, 1928.) Price 5 cents.

Onze Koffiebereiding. By D. S. Fernandes. *Med. No. 3, Landbouwproefstation, Suriname*. Pp. 13, 9 x 6. (Paramaribo: J. H. Oliveira, 1928.)

Premières observations sur les floraisons et fructifications des Caféiers de la Station expérimentale de Phu-Ho. By M. Du Pasquier. *Bull. Econ. Indochine* (1928, 31, 369-385).

Voorloopige Mededeeling over de Oorzaak van de Zeefvatenziekte (phloemnecrose) bij de Liberiakoffie en hare Bestrijding. By D. S. Fernandes. *Med. No. 2, Landbouwproefstation, Suriname*. Pp. 12, 9 x 6. (Paramaribo: J. H. Oliveira, 1928.)

Culture of Chicory (Witloof) in Belgium. By O. F. Wuyts. *Journ. Ministry Agric.* (1928, 35, 430-438).

Annual Report of the Tea Research Institute of Ceylon for the Year 1927. *Bull. No. 2*. Pp. 43, 9½ x 6. (Kandy: The Tea Research Institute of Ceylon, 1928.)

The Use of Artificial Manures for Tea. By H. R. Cooper. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1928, 2, 63-79).

Plucking Experiments at Borbhetta. By H. R. Cooper. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1928, 3, 107-126).

Soil Survey of the Cachar District. By C. R. Harler. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1928, 3, 127-160).

Soil Wash. By P. H. Carpenter. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1928, 3, 161-172).

On the Incidence of Insect Pests and Fungus Diseases on Tea at Tocklai. By E. A. Andrews. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1928, 3, 173-177).

Notes on the Growth of Young Tea Plants and its Relation to Red Spider Attack. By E. A. Andrews. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1928, 2, 80-89).

The Parasitism of *Rosellinia arcuata*. By C. H. Gadd. *Tea Quarterly, Ceylon* (1928, 1, 55-60).

Moisture Changes during the Manufacture of Black Tea. By C. R. Harler. *Quart. Journ., Sci. Dept., Indian Tea Assoc.* (1928, 2, 90-98).

### Cereals

Field Technique in Cereal Breeding in New South Wales. By J. T. Pridham. *Agric. Gaz., N.S.W.* (1928, 39, 591-596).

Irrigation of Small Grain. By W. W. McLaughlin. *Farmers' Bull. No. 1556, U.S. Dept. Agric.* Pp. 13, 9 × 6. (Washington, D.C. : U.S. Government Printing Office, 1928.) Price 5 cents.

Experiments with Small Grains in Southern Arizona. By I. A. Briggs and R. S. Hawkins. *Bull. No. 126, Agric. Exper. Sta., Arizona.* Pp. 20, 9 × 6. (Tucson, Arizona : University of Arizona, 1928.)

Survey of Diseases of Cereals in New Zealand. By J. C. Neill. *New Zealand Journ. Agric.* (1928, 37, 89-93).

Corn Growing. By E. D. Holden. *Special Circ., Wisconsin Coll. Agric.* Pp. 8, 9 × 6. (Madison, Wisconsin : University of Wisconsin, 1928.)

Corn Growing in Minnesota. By A. C. Arny. *Spec. Bull. No. 118, Agric. Exper. Sta., Minnesota.* Pp. 20, 9 × 6. (Minnesota : University of Minnesota, 1928.)

Corn Root Rot Studies. By B. B. Branstetter. *Res. Bull. 113, Agric. Exper. Sta., Missouri.* Pp. 80, 9 × 6. (Columbia, Missouri : University of Missouri, 1927.)

A Bibliography of the European Corn Borer (*Pyrausta nubilalis* Hbn.). By J. S. Wade. *Misc. Circ. No. 46, U.S. Dept. Agric.* Pp. 34, 9 × 5½. (Washington, D.C. : U.S. Government Printing Office, 1928.)

Witch Weed or Rooibloem (*Striga lutea*). A Serious Menace of Maize. By J. A. T. Walters. *Rhodesia Agric. Journ.* (1928, 25, 1035-1039).

Annual Report of the Millets Breeding Station, Agricultural Research Institute, Coimbatore, Madras, for 1927-1928. By G. N. Rangaswami Ayyangar. Pp. 7, 9½ × 6. (Madras : Superintendent, Government Press, 1928.)

Selection in the "Jowars" of the Bombay Karnatak. By G. L. Kottur and V. M. Chavan. *Bull. No. 151, Dept. Agric., Bombay.* Pp. 24, 9½ × 6. (Bombay : Government Central Press, 1928.) Price As. 6 (8d.).

Banner Oats. The Best Variety for Quebec. By G. A. Langelier. *Bull. No. 91, New Series, Dept. Agric., Canada.* Pp. 8, 9½ × 6½. (Ottawa : King's Printer, 1927.)

Oat Smuts. By R. J. Noble. *Agric. Gaz., N.S.W.* (1928, 39, 516-518).

Annual Report of the Paddy Breeding Station, Aduturai, Madras, for the Year 1927-28. Pp. 29, 10 × 6. (Madras : Superintendent, Government Press, 1928.)

Annual Report of the Paddy Breeding Station, Maruteru, Madras, for the Year 1927-28. Pp. 49, 9½ × 6.

Studies on Rice in Sind, Part I. By K. I. Thadani and H. V. Durga Dutt. *Mem. Dept. Agric., India, Bot. Series, vol. xv, No. 6.* Pp. 47, 9½ × 7½. (Calcutta : Government of India Central Publication Branch, 1928.) Price Re.1 (1s. 9d.).

Some of the Limiting Factors in the Improvement of Paddy Cultivation in Ceylon. By L. Lord. *Trop. Agric., Ceylon* (1928, **70**, 374-382).  
Experiments on Upland Rice at La Carlota and Alabang Rice Experiment Stations from 1916 to 1926. *Philippine Agric. Rev.* (1928, **21**, 20-54).

The History and Present Status of Wheat Production in Canada, together with a Review of the Part Played by the Plant Breeder in Introducing Superior Varieties. By L. H. Newman. *Pamphlet No. 89, New Series, Dept. Agric., Canada*. Pp. 10, 9½ × 6½. (Ottawa: King's Printer, 1928.)

Classification of Canadian Spring Wheat Varieties. By L. H. Newman. *Plant Breeders Series No. 1, Canadian Seed Growers' Association*. Pp. 29, 9½ × 6½. (Ottawa: King's Printer, 1928.)

Cultural Experiments with Wheat for Grain and Forage Production. By C. E. Hill. *Bull. No. 227, Agric. Exper. Sta., Washington*. Pp. 45, 9 × 6. (Pullman, Washington: State College, 1928.)

Root Rot and Sclerotial Diseases of Wheat. By L. S. Subramaniam. *Bull. No. 177, Agric. Res. Inst., Pusa*. Pp. 7, 9½ × 7½. (Calcutta: Government of India Central Publication Branch, 1928.) Price As. 4 (5d.).

### Sugar

Conditions techniques et financières de la production du sucre aux Philippines (cont.). Part II, Organisation de la Culture. Part III, Organisation de l'industrie. By Y. Henry. *Bull. Econ. Indochine* (1928, **31**, 233-343).

Sugar-Cane Variety Tests in Louisiana during the Crop Year 1926-27. By R. D. Rands, S. F. Sherwood and F. D. Stevens. *Circ. No. 36, U.S. Dept. Agric.* Pp. 14, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.)

The Effect of Stripping off the Dead Leaves of Sugar Cane on the Yield of Sugar. By M. Medina. *Philippine Agric. Rev.* (1928, **21**, 72-77).

A Preliminary Note on the Effect of Manurial Constituents on the Quality of Sugarcane Juice and Gur. By P. B. Sanyal. *Agric. Journ., India* (1928, **23**, 277-286).

Mosaic Disease of Sugar Cane. By R. D. Anstead. *Bull. No. 92, Agric. Dept., Madras*. Pp. 13, 9½ × 6. (Madras: Superintendent, Government Press, 1928.) Price As. 6.

A Further Note on the Mosaic Disease of Sugarcane. By W. McRae and L. S. Subramaniam. *Agric. Journ., India* (1928, **23**, 239-255).

Progress Report on the *Coccinellidæ* imported from Trinidad to Control *Aspidiotus destructor*. By T. H. C. Taylor. *Agric. Journ., Fiji* (1928, **1**, 7).

Sugar Beet Cultivation. By W. Bruce. *Trans. Highland and Agric. Soc., Scotland* (1928, **36**, 92-115).

Report on Sugar Beet Experiments, 1927. *Dept. Lands and Agric., Irish Free State*. Pp. 39, 13 × 8½. (Dublin: Stationery Office, 1928.)

### Root Crops

Annual Report of the Potato Experiment Station, Nanjanad, Madras, for the Year 1927-28. By F. H. Butcher. Pp. 16, 9½ × 6. (Madras: Superintendent, Government Press, 1928.)

Potato-Culture. The Maintenance of Pure and Vigorous Crops. By J. W. Hadfield. *New Zealand Journ. Agric.* (1928, **37**, 73-84).

A Review of Literature dealing with the Degeneration of Varieties of the Potato. By W. D. Davidson. *Econ. Proc. Roy. Dublin Soc.* (1928, **2**, 331-389).

**Factors in the Inception and Development of Fusarium Rot in Stored Potatoes.** By F. Weiss, J. I. Lauritzen and P. Brierley. *Tech. Bull. No. 62, U.S. Dept. Agric.* Pp. 35, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 15 cents.

### Fruits

**A Report on the Fruit Inspection Service.** By A. C. Shill. *Agric. Leaflet, Series IV, No. 13, Horticulture, Dept. Agric. and Forests, Palestine.* Pp. 35, 8½ × 5½. (1928.)

**Preliminary Notes on Fruit Inspection.** By B. W. Harlow and A. C. Shill. *Agric. Leaflet No. 12, Series IV, Horticulture, Dept. Agric. and Forests, Palestine.* Pp. 8, 8½ × 5½.

**An Economic Study of Certain Phases of Fruit Marketing in Western New York.** By R. B. Corbett. *Bull. 464, Cornell Agric. Exper. Sta.* Pp. 51, 9 × 6. (Ithaca, New York: Cornell University, 1928.)

**Notes on Manuring Fruit Trees and Vines.** By G. Quinn. *Journ. Dept. Agric., S. Australia* (1928, **32**, 26-33).

**Propagation of Fruit Trees.** By C. L. Vincent and W. A. Luce. *Pop. Bull. No. 141, Washington Agric. Exp. Sta.* Pp. 45, 9 × 6. (Pullman, Washington: State College, 1928.)

**Some Results of Pruning Experiments with Deciduous Fruit Trees.** By O. S. H. Reinecke. *Bull. No. 43, Dept. Agric., Union of S. Africa.* Pp. 15, 9½ × 6. (Pretoria: The Government Printing and Stationery Office, 1928.)

**Orchard Heating and Smudge Firing (cont.).** By H. Broadfoot. *Agric. Gaz., N.S.W.* (1928, **39**, 465-470).

**Frost-Prevention for Orchards (cont.).** By W. R. Lloyd Williams. *New Zealand Journ. Agric.* (1928, **36**, 382-401; 1928, **37**, 19-29; 1928, **38**, 106-117).

**Fruit-Fly (*Ceratitis capitata*).** Baiting and Trapping Experiments. By L. J. Newman. *Journ. Dept. Agric., W. Australia* (1928, **5**, 229-234).

**Fruit Fly (*Ceratitis capitata*).** Trapping or Luring Methods. By L. J. Newman. *Journ. Dept. Agric., W. Australia* (1928, **5**, 246-251).

**Wastage in Australian Fruit Exported to England.** By J. Barker. *Journ. Coun. Sci. and Indust. Res., Australia* (1928, **1**, 261-267).

**Cold Storage of Fruit.** By F. Kidd. *New Zealand Journ. Sci. and Tech.* (1928, **10**, 80-89).

**Dehydration of Fruits and Vegetables in Canada.** Summary of Four Years' Work of the Dehydration Committee, Department of Agriculture, Ottawa. *Bull. No. 90, New Series, Dept. Agric., Canada.* Pp. 29, 9½ × 6½. (Ottawa: King's Printer, 1927.)

**Report on the Work of the Pomological Station at Coonoor and the Burliar and Kallar Fruit Gardens, Madras, for the Year 1927-28.** By F. H. Butcher. Pp. 12, 9½ × 6. (Madras: Superintendent, Government Press, 1928.)

**The Apple Industry of Ohio.** By C. W. Hauck. *Bull. 418, Agric. Exper. Sta., Ohio.* Pp. 70, 9 × 6. (Wooster, Ohio: Agricultural Experiment Station, 1928.)

**The Storage of Apples in Air-Cooled Warehouses in Nova Scotia.** *Report No. 23, Nat. Res. Coun., Canada.* Pp. 22, 9½ × 6½. (Ottawa: King's Printer, 1928.)

**"Blossom-Wilt" of Apple Trees and "Wither-Tip" of Plum Trees, with Special Reference to two Biologic Forms of *Monilia cinerea* Bon.** By C. Boyle, M. Murphy and H. A. Cummins. *Sci. Proc. Roy. Dublin Soc.* (1928, **19**, 63-76).

**Spraying for Prevention of Apple Blotch and Apple Scab.** By F. H. Ballou and I. P. Lewis. *Bull. 413, Agric. Exper. Sta., Ohio.* Pp. 32, 9 × 6. (Wooster, Ohio: State Experiment Station, 1927.)



The Apple Maggot. By B. A. Porter. *Tech. Bull. No. 66, U.S. Dept. Agric.* Pp. 48, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 15 cents.

Arsenical Spray Residue and its Removal from Apples and Pears. By F. D. Heald, J. R. Neller and F. L. Overley, with the assistance of G. D. Ruehle and W. A. Luce. *Bull. No. 220, Washington Agric. Exp. Sta.* Pp. 100, 9 × 6. (Pullman, Washington: State College, 1928.)

The Removal of Spray Residue from Apples and Pears in Washington State. By J. R. Magness, F. L. Overley, F. D. Heald, J. R. Neller, D. F. Fisher and H. C. Diehl. *Popular Bull. No. 142, Washington Agric. Exp. Sta.* Pp. 29, 9 × 6. (Pullman, Washington: State College, 1928.)

Removal of Spray Residue from Apples and Pears. By H. Hartman, R. H. Robinson, and S. M. Zeller. *Sta. Bull. 234, Oregon Agric. Exp. Sta.* Pp. 38, 9 × 6. (Corvallis, Oregon: State College, 1928.)

Invoer van Sawo Manila (*Achras Sapota*) te Amsterdam. By W. Spoon. *Berichten No. 35, van de Afdeel. Handelsmuseum van de Kon. Vereen. Kol. Instituut.* Pp. 10, 8½ × 5½. (Amsterdam: Koloniaal Instituut, 1928.) Price Fl.0.40. Reprinted from *De Indische Mercur* of 28 March, 1928.

Propagation de l'Avocatier. By W. Popenoe and A. F. Butter. *Rev. Bot. App. et d'Agric. Col.* (1928, 8, 478-482).

St. Lucia's Banana Industry. By E. A. Walters. *Trop. Agric., W.I.* (1928, 5, 247-249; 284-286).

Cultivation of Plantains on Wet Lands in the Godavari Delta. *Bull. No. 93, Agric. Dept., Madras.* Pp. 8, 9½ × 6. (Madras: Superintendent, Government Press, 1928.) Price As.2.

Review of Grapefruit Production in British Honduras. By H. Clark Powell. Pp. 23, 8 × 6½. (Belize: Government Printing Office, 1928.)

Report of the Grape Export Committee. *Agric. Leaflet, No. 14, Series IV, Horticulture, Dept. Agric. and Forests, Palestine.* Pp. 26, 8½ × 5½.

Citrus Chlorosis as Affected by Irrigation and Fertilizer Treatments. By P. S. Burgess and G. G. Pohlman. *Bull. No. 124, Agric. Exper. Sta., Arizona.* Pp. 49, 9 × 6. (Tucson, Arizona: University of Arizona, 1928.)

Invoer van Doerian-Vruchten in Nederland. By W. Spoon. *Berichten No. 37, van de Afdeel. Handelsmuseum van de Kon. Vereen. Kol. Instituut.* Pp. 10, 8½ × 5½. (Amsterdam: Koloniaal Instituut, 1928.) Price Fl.0.40. Reprinted from *De Indische Mercur*, 1 August, 1928.

Marketing California Grapes. By E. W. Stillwell and W. F. Cox. *Circ. No. 44, U.S. Dept. Agric.* Pp. 153, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 25 cents.

Culture of Guava and its Improvement by Selection in Western India. By C. S. Cheema and G. B. Deshmukh. *Bull. No. 148 of 1927, Dept. Agric., Bombay.* Pp. 17, 9½ × 6. (Poona: Yeravda Prison Press, 1928.) Price As. 7-3 (9d.).

Studies in the Shedding of Mango Flowers and Fruits, Part I. By P. V. Wagle. *Mem. Dept. Agric., India, Bot. Series, vol. xv, No. 8.* Pp. 30, 9½ × 7½. (Calcutta: Government of India Publication Branch, 1928.) Price As. 11 (1s. 3d.).

Notes on Passion Fruits. By E. Cheel. *Agric. Gaz., N.S.W.* (1928, 39, 471-477).

Passion-Fruit and its Culture. By W. H. Rice. *New Zealand Journ. Agric.* (1928, 36, 405-408).

Woodiness of Passion-fruit. Cause of the Disease Discovered. By R. J. Noble. *Agric. Gaz., New South Wales* (1928, 39, 681-683).

Insects Attacking the Peach in the South and How to Control Them. By O. I. Snapp. *Farmers' Bull.* No. 1557, U.S. Dept. Agric. Pp. 42, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.)

Proceedings of the Pineapple Men's Conference, April 2-3, 1928. Pp. 103, 9 × 6. (Honolulu: Association of Hawaiian Pineapple Cannors, 1928.)

Pineapple Disease Investigation. Interim Report. By H. Tryon. *Queensland Agric. Journ.* (1928, 30, 26-34).

### Spices

Sur un nouvel ennemi de la Vanille (*Perissodores oblongus* Hust.). By E. François. *Rev. Bot. App. et d'Agric. Col.* (1928, 8, 617-620).

Les maladies du vanillier à Eala. By Dr. Staner. *Bull. Agric. Congo Belge* (1928, 19, 83-90).

### Fodders and Forage Crops

Recent Developments in Grassland Management. By Sir A. D. Hall and J. G. Stewart. *Journ. Ministry Agric.* (1928, 35, 607-612).

Seeds Mixture Problems: Competition. By R. G. Stapledon and W. Davies. *Welsh Plant Breeding Station, Series H, No. 8. Seasons 1921-1928.* Pp. 161, 9½ × 7½. (Aberystwyth: University College of Wales, 1928.) Price 3s. 6d.

Species in Relation to the Management and Improvement of Grassland. By R. G. Stapledon. *Scottish Journ. Agric.* (1928, 11, 125-130).

Some Hay and Pasture Experiments. By W. G. R. Paterson. *Trans. Highland and Agric. Soc., Scotland* (1928, 40, 40-50).

The Importance of Research on Pasture Improvement in Southern Rhodesia. By A. D. Husband. *Rhodesia Agric. Journ.* (1928, 25, 992-1002).

Some Results secured in "Top-Dressing" Poor South-eastern Pasture Land with Phosphatic Fertilisers. By A. J. Perkins. *Journ. Dept. Agric., S. Australia* (1928, 31, 1120-1135; 1928, 32, 11-24; cont.).

Pasture Top-Dressing Experiments in Otago, Season 1927-28 (cont.). By R. B. Tennent. *New Zealand Journ. Agric.* (1928, 37, 38-48).

Top-Dressing of Hill-Country Pastures. Trials on King-Country Farms. By J. E. F. Jenks. *New Zealand Journ. Agric.* (1928, 36, 371-376).

Digestibility Trials on Indian Feeding Stuffs, III. Some Punjab Hays. By P. E. Lander and Pandit Lal Chand Dharmani. *Mem. Dept. Agric., India, Chem. Series, vol. ix, No. 7.* Pp. 11, 9½ × 7½. (Calcutta: Government of India Central Publication Branch, 1928.) Price As. 5 (6d.).

The Indian Types of *Lathyrus sativus* L. (khesari, lakh, lang, teora). By G. L. C. Howard and K. S. Abdur Rahman Khan. *Mem. Dept. Agric., India, Bot. Series, vol. xv, No. 2.* Pp. 22, 9½ × 7½. (Calcutta: Government of India Central Publication Branch, 1928.) Price Re. 1-8 (2s. 6d.).

Top-Dressing Lucerne. By L. C. Bartels. *Journ. Agric., Victoria* (1928, 26, 397-401).

Bacterial Wilt and Winter Injury of Alfalfa. By F. R. Jones and J. L. Weimer. *Cir. No. 39, U.S. Dept. Agric.* Pp. 8, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 5 cents.

Growing and Feeding Field Roots. By E. S. Hopkins, G. B. Rothwell, F. C. Elford, and F. T. Shutt. *Bull. No. 94, New Series,*

*Dept. Agric., Canada.* Pp. 35,  $9\frac{1}{2} \times 6\frac{1}{4}$ . (Ottawa: King's Printer, 1927.)

Soybeans and Soybean Hay in the Dairy Ration. By O. G. Schaefer. *Bull.* 239, *Minnesota Agric. Exp. Sta.* Pp. 16,  $9 \times 6$ . (St. Paul, Minnesota: University of Minnesota, 1927.)

The Conversion of Dry Roughage into a Succulent Feed. An Examination of the Sugar Jack Process. *Bull.* No. 96, *New Series, Dept. Agric., Canada.* Pp. 38,  $9\frac{1}{2} \times 6\frac{1}{4}$ . (Ottawa: King's Printer, 1927.)

River Myall or Sally Wattle (*Acacia glaucescens*) Proved Poisonous to Stock. By H. R. Seddon and H. C. White. *Agric. Gaz., New South Wales* (1928, 39, 668-670).

*Astragalus campestris* and other Stock-poisoning Plants of British Columbia. By E. A. Bruce. *Bull.* No. 88, *Dept. Agric., Canada.* Pp. 44,  $9\frac{1}{2} \times 6\frac{1}{4}$ . (Ottawa: King's Printer, 1927.)

*Euphorbia Drummondii*, "Milk Weed," a Plant Poisonous to Sheep. By H. R. Seddon. *Journ. Coun. Sci. and Indust. Res., Australia* (1928, 1, 268-273).

The Greasewood (*Sarcobatus vermiculatus*). A Range Plant Poisonous to Sheep. By C. E. Fleming, assisted by M. R. Miller and L. R. Vawter. *Bull.* No. 115, *Nevada Agric. Exp. Sta.* Pp. 22,  $9 \times 6$ . (Reno, Nevada: University of Nevada, 1928.)

#### Oils and Oil Seeds

Apontamentos Sobre as Sementes Oleaginosas, os Balsamos e as Resinas da Floresta Amazonica. By P. Le Cointe. 3rd Edition. Pp. 41,  $9 \times 6\frac{1}{4}$ . (Belem, Para: Museu Commercial do Pará, 1927.)

Les Marchés des Matières Grasses en 1927. *Service de Statistique et d'Information, Union des Fabricants d'Huile de France.* Pp. 70,  $11 \times 8\frac{1}{2}$ . (Paris: Croutzet & Depost, 1928.)

Preliminary on the Cultivation of the Candle-nut at Serdang. By T. D. Marsh. *Malayan Agric. Journ.* (1928, 16, 212-216).

Annual Report of the Four Coconut Experiment Stations in Kasaragod Taluk of South Kanara District, Madras, for 1927-28. By M. Govinda Kidavu. Pp. 54,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

Atuabo Coconut Plantation. By C. H. Knowles. *Year-book, Dept. Agric., Gold Coast*, 1927. Pp. 107-114.

Variations in Yields of Coconuts at Asuansi. *Year-book, Dept. Agric., Gold Coast*, 1927. Pp. 115-122.

Investigation of Root Diseases of Coconuts. By M. Park. *Trop. Agric., Ceylon* (1928, 70, 402-408).

Annual Report of the Groundnut Experiment Station, Palakuppam, Madras, for the Year 1927-28. By D. Ananda Rao. Pp. 20,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

Il seme di lino dell'Eritrea. By A. Ferrara. *Agricolt. Col.* (1928, 22, 321-328).

The Oil Palm Industry. By F. J. Martin. *Trop. Agric., W.I.* (1928, 5, 189-193).

Oil Palm (*Elais guineensis* Jacq.). *Bull.* 64, *Dept. Agric., New Guinea.* (Rabaul, 1928.)

Oil Palm Yields on Cleaned Groves at Peki Blengo. By A. W. Paterson. *Year-book, Dept. Agric., Gold Coast*, 1927, pp. 123-124.

De Fabricage van Palmolie. By H. N. Blommendaal. *Med. Alg. Proefsta., A.V.R.O.S., Algemeene Serie* No. 33. Pp. 116,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Medan: Typ. Varekamp & Co.) [Summary in English.]

Le Sésame dans les districts du Nord et de l'Est du Congo Belge. *Bull. Agric. Congo Belge* (1928, 19, 132-141).

Distribution and Yields of Shea Butternut Trees in the Northern Territories. By G. C. Coull. *Year-book, Dept. Agric., Gold Coast*, 1927, pp. 130-137.

A Simple Method for Determining the Oil Content of Seeds and other Oil-bearing Materials. By D. A. Coleman and H. C. Fellows. *Tech. Bull. No. 71, U.S. Dept. Agric.* Pp. 13, 9 × 6. (Washington, D.C.: Government Printing Office, 1928.) Price 5 cents.

### Essential Oils

Schimmel & Co.'s Annual Report on Essential Oils, Synthetic Perfumes, etc. Pp. 249, 9 × 6. (Miltitz, Leipzig: Schimmel & Co., 1927.)

Verdere Mededeelingen over de Bepaling van Het z.G. "Totaal-Geraniol-Gehalte" in Java-Citronellaolie en over het Analytisch Onderzoek van die Olie in het Algemeen. By A. Reclaire and D. B. Spoelstra. *Berichten No. 36, van de Afdel. Handelsmuseum van de Kon. Vereen. Kol. Instituut*. Pp. 11, 8½ × 5½. (Amsterdam: Koloniaal Instituut, 1928.) Price Fl. 0.40. Reprinted from *De Indische Mercur*, 20 June, 1928.

### Fibres

The Abaca Project of La Carlota Experiment Station. By A. F. Labrador. *Philippine Agric. Rev.* (1928, 21, 3-19).

Observations sur les Agaves producteurs de fibres et d'alcool. By L. H. Dewey. *Rev. Bot. App. et d'Agric. Col.* (1928, 8, 557-562).

Accra Sisal Plantation during 1926-1927. By J. E. Symond. *Year-book, Dept. Agric., Gold Coast*, 1927, pp. 125-129.

Yucatan's Henequen (Mexican Sisal). By M. Diaz de Cossio. Pp. 37, 9½ × 6½. (Barcelona: Talleres Gráficos Hostench, 1928.)

La Sericulture en France. By J. G.-C. *Rev. Bot. App. et d'Agric. Col.* (1928, 8, 652-657).

Growing and Marketing Wool. By P. A. Anderson. *Spec. Bull. No. 117, Agric. Exper. Sta., Minnesota*. Pp. 14, 9 × 6. (Minnesota: University of Minnesota, 1928.)

### Cotton

Annual Report of the Cotton Breeding Station, Kovilpatti, Madras, for 1927-28. By V. Ramanathan. Pp. 12, 9½ × 6. (Madras: Superintendent, Government Press, 1928.)

Studies in Gujarat Cottons, Part V. Variability of Certain Economic Characters, particularly in Seed Weight and Weight of Lint per Seed in Pure Strains of Broach-Deshi Cotton. By M. L. Patel and H. H. Mann. *Mem. Dept. Agric., India, Bot. Series, vol. xv, No. 7*. Pp. 57, 9½ × 7½. (Calcutta: Government of India Central Publication Branch, 1928.) Price As. 14 (1s. 6d.).

Research in Cotton Technology in India, 1927. By A. J. Turner. *Bull. No. 13, Tech. Series No. 8, Indian Central Cotton Committee Technological Laboratory*. Pp. 26, 9½ × 6½. (Bombay: British India Press, 1928.) Price Re. 1.

Technological Reports on Standard Indian Cottons, 1928. By A. J. Turner. *Bull. No. 16, Technolog. Series No. 11, Indian Central Cotton Committee Technological Laboratory*. Pp. 117, 13½ × 8½. (Bombay: The Times Press, 1928.) Price As. 2.

La production du Coton dans les Colonies Françaises. By M. G. Masquelier. *Rev. Bot. app. et d'Agric. Col.* (1928, 8, 563-567).

La culture du cotonnier au Lomami. By A. Berenz. *Bull. Agric. Congo Belge* (1928, 10, 105-112).

Fifth Annual Report, 1924, Cotton Research Board, Ministry of

Agriculture, Egypt. Pp. 85,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Cairo: Government Press, 1928.) Price P.T.15.

Die Baumwollkultur in Paraguay. By A. Langer. *Tropenpflanzer* (1928, 81, 340-360).

The Irrigation of Cotton. By J. C. Marr and R. G. Hemphill. *Tech. Bull. No. 72, U.S. Dept. Agric.* Pp. 37,  $9 \times 6$ . (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 10 cents.

Marketing American Cotton in England. By A. B. Cox. *Tech. Bull. No. 69, U.S. Dept. Agric.* Pp. 87,  $9 \times 6$ . (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 20 cents.

Marketing American Cotton on the Continent of Europe. By B. Cox. *Tech. Bull. No. 78, U.S. Dept. Agric.* Pp. 95,  $9 \times 6$ . (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 20 cents.

The Fusarium Disease of Cotton (Wilt) and its Control. By Tewfik Fahmy. *Bull. No. 74, Plant Protection Sect., Mycological Res. Div., Tech. and Sci. Serv., Min. Agric., Egypt.* Pp. 106  $\times$  50 plates,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Cairo: Government Press, 1928.) Price P.T.25.

Stained Cotton in Fiji and its Causes. By H. W. Simmonds. *Agric. Journ., Fiji* (1928, 1, 10-12).

Cotton Pests of Southern British Togoland and Trans-Volta District. By G. S. Cotterell. *Bull. No. 12, Dept. Agric., Gold Coast.* Pp. 42,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (Accra: Government Printing Office, 1928.)

Studies on *Platyedra gossypiella* Saunders (Pink Bollworm) in Punjab. Part I. By Sohan Singh Bindra. *Mem. Dept. Agric., India, Entom. Series, vol. x, No. 6.* Pp. 216,  $9\frac{1}{2} \times 7\frac{1}{2}$ . (Calcutta: Government of India Central Publication Branch, 1928.) Price, Re.1-4 (2s. 3d.).

Studies on the Transport of Carbohydrates in the Cotton Plant. By T. G. Mason and E. J. Maskell. *Mem. Cotton Res. Sta., Trinidad, Series B, Physiology, No. 1.* Pp. 132,  $9\frac{1}{2} \times 6\frac{1}{2}$ . (London: Empire Cotton Growing Corporation, 1928.)

#### Paper-making Materials

Kraft Paper from *Pinus insignis*. Observations by the Inspector-General of Forests, Mr. C. E. Lane-Poole, on the Council's *Bulletin* 35. *Journ. Coun. Sci. and Indust. Res., Australia* (1928, 1, 296-304).

Essais de traitement du bois des Palétuviers de Madagascar, faits à l'Ecole française de Papeterie. By L. Vidal and M. Aribert. *Agron. Col.* (1928, 17, No. 126, 201-212).

#### Rubber

Quelques Problèmes de l'Hévéa culture moderne. By M. Guillaume. *Agron. Col.* (1928, 17, No. 127, pp. 1-8; No. 128, pp. 46-51).

Experimental Tapping of Hevea Rubber Trees at Bayeux, Haiti, 1924-25. By L. G. Polhamus. *Tech. Bull. No. 65, U.S. Dept. Agric.* Pp. 31,  $9 \times 6$ . (Washington, D.C.: Government Printing Office, 1928.) Price 5 cents.

Natriumsilicofluoride als Coagulant. Sodium Silico-Fluoride as a Coagulant. By N. H. van Harpen. *Med. Alg. Proefsta., A.V.R.O.S., Rubberserie No. 62.* Pp. 18,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Batavia: Drukkerij Ruygrok & Co., 1928.) [In Dutch and English.]

Plasticity and Elasticity of Rubber. By A. Van Rossem and H. Van der Meyden. Extract from "Congrès International pour l'Essai des Matériaux, Amsterdam, 12th-17th September, 1927." Pp. 8,  $10\frac{1}{2} \times 7\frac{1}{2}$ . (Delft: Netherland Government Rubber Institute, 1927.)

Brown Bast of Rubber and its Treatment. By A. J. Mitchell. *Bull. No. 48, Rubber Research Scheme (Ceylon).* Pp. 6 + vii plates,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (Colombo: Government Printer, 1928.)

Verdere Opmerkingen over Exploitatie van Euphorbia's in Zuid-Afrika; onderzoek van Hars en Caoutchouc. By W. Spoon and M. van Royen. *Berichten No. 34, van de Afdel. Handelsmuseum van de Kon. Vereen. Kol. Instituut*. Pp. 10,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (Amsterdam: Koloniaal Instituut, 1928.) Price Fl. 0.40. Reprinted from *De Indische Mercuur* of March 14, 1928.

Jelutong. By C. D. V. Georgi. *Malayan Agric. Journ.* (1928, 18, 204-211).

The Valuation of Jelutong. By C. D. V. Georgi. *Malayan Agric. Journ.* (1928, 18, 220-233).

### Tobacco

Tobacco. Ninth Report of the Imperial Economic Committee. Pp. 50,  $9\frac{1}{2} \times 6$ . (London: H.M. Stationery Office, 1928.) Price 9d.

India and the Leaf Tobacco Trade of the British Empire. By F. J. F. Shaw. *Agric. Journ., India* (1928, 23, 267-270).

Some Experiments on Tobacco in the Experimental Station in Ilagan, Isabela. *Philippine Agric. Rev.* (1928, 21, 55-71).

I. Bemestingsproeven bij Tabak in 1926-27. II. Proeven met Stoomfermentatie. By L. R. Van Dillen. *Med. No. 44, Besoekisch Proefstation*. Pp. 14,  $10 \times 7\frac{1}{2}$ . 1928.

Wildfire of Tobacco. I. Studies on Overwintering and Dissemination of Wildfire. By E. S. Moore. II. Methods of Seed treatment for the Control of Wildfire. By E. S. Moore and P. J. Maude. *Sci. Bull. No. 54, Dept. Agric., Union of South Africa*. Pp. 23,  $9\frac{1}{2} \times 6$ . (Pretoria: Government Printing Office, 1927.) Price 3d.

### Drugs

Report of the Betel Vine Experiment Station, Vellalur, Madras, for the Year 1927-28. By D. G. Munro. Pp. 16,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

The Stem-Bleeding Disease of Arecanut (*Areca catechu*) caused by *Thielaviopsis paradoxa* von Hon. By S. Sundararaman, C. Krishnan Nayar, and T. S. Ramakrishnan. *Bull. No. 169, Agr. Res. Inst., Pusa*. Pp. 12,  $10 \times 7\frac{1}{2}$ . (Calcutta: Government of India Central Publication Branch, 1928.) Price As. 9 (1s.).

La coltura della papaya e l'estrazione della papaina. By A. Maugini. *Agricolt. Col.* (1928, 22, 329-332).

### Livestock

Annual Report of the Department of Veterinary Science and Animal Husbandry, Tanganyika Territory, for 1927. Pp. 45,  $13\frac{1}{2} \times 8\frac{1}{2}$ . (London: Crown Agents for the Colonies, 1928.) Price 3s.

The Livestock Review for 1927. By H. M. Conway. *Misc. Pub. No. 28, U.S. Dept. Agric.* Pp. 44,  $9 \times 6$ . (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 10 cents.

Economic Calf-Rearing. By J. A. Crichton. *Agric. Leaflet, Series V, No. 2, Livestock Management, Dept. Agric. and Forests, Palestine*. Pp. 35,  $8\frac{1}{2} \times 5\frac{1}{2}$ . 1928.

Dairy Farming in Cyprus, Its Present Position. By M. T. Dawe. *Agric. Suppl. No. 1, Cyprus Gaz. No. 1934, July 27, 1928*.

Annual Report of the Ongole Cattle Farm, Chintaladevi, for 1927-28. By R. W. Littlewood. *Dept. Agric., Madras*. Pp. 15,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

Annual Report of the Buffalo-Breeding Station, Guntur, for 1927-28. By R. W. Littlewood. *Dept. Agric., Madras*. Pp. 8,  $9\frac{1}{2} \times 6$ . (Madras: Superintendent, Government Press, 1928.)

Dairying in Queensland. *Queensland Agric. Journ.* (1928, 20, 119-137).

The Testing of Pure-bred Cows in New South Wales (No. 9). By L. T. MacInnes. *Farmers' Bull.* No. 162, *Dept. Agric., N.S. Wales.* Pp. 40, 9½ × 6. (Sydney: Government Printer, 1928.)

Ranch Organisation and Methods of Livestock Production in the South-west. By V. V. Parr, G. W. Collier, and G. S. Klemmedson. *Tech. Bull.* No. 68, *U.S. Dept. Agric.* Pp. 103, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 25 cents.

Merino Sheep in Rhodesia. The Inyagura Flock. By E. G. F. Salmon. *Rhodesia Agric. Journ.* (1928, 25, 912-914).

La pecora nel Molise. By P. Fabrizio. *L'Italia Agricola* (1928, 6, 283-295).

Report from the Select Committee on Horse-Breeding, together with the Proceedings of the Committee, Minutes of Evidence and Appendix. Parliament of the Union of South Africa. Pp. 101, 13 × 8. (1928.) Price 5s.

Live Stock Diseases Report, No. 3. By M. Henry. *Sci. Bull.* No. 30, *Dept. Agric., N.S. Wales.* Pp. 31, 9½ × 6. (Sydney: Government Printer, 1928.)

Report of the Foot-and-Mouth-Disease Commission of the United States Department of Agriculture. By P. K. Olitsky, J. Traum, and H. W. Schoening. *Tech. Bull.* No. 76, *U.S. Dept. Agric.* Pp. 172, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 25 cents.

Sheep Blow-Fly Control. Fly-traps: Their Construction and Operation. By B. Smit. *Bull.* No. 38, *Dept. Agric., Union of South Africa.* Pp. 14, 9½ × 6. (Pretoria: Government Printing and Stationery Office, 1928.) Price 3d.

Chinchilla Rabbits for Food and Fur. By D. M. Green. *Leaflet* No. 22, *U.S. Dept. Agric.* Pp. 6, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 5 cents.

## FORESTRY

### General

Eighth Annual Report of the Forestry Commissioners, Year ending September 30th, 1927. Pp. 35, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 9d.

Report of the Forest Commission on Census of Woodlands and Census of Production of Home-Grown Timber, 1924. Pp. 68, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 1s. 9d.

Survey of the Waste Land of North County Wicklow suitable for Afforestation. By S. Leonard. *Econ. Proc. Roy. Dublin Soc.* (1928, 2, 391-405).

Report of the Forest Authority for Ceylon, prepared for the British Empire Forestry Conference, Australia and New Zealand, 1928. *Sessional Paper XXIX*, 1928. Pp. 23, 13½ × 8½. (Colombo: Government Printer, 1928.) Price 50 cents.

Report on Forest Administration, Federated Malay States, for the Year 1927. Supplement to the *F.M.S. Government Gazette*, May 25, 1928. Pp. 78, 13½ × 9½.

Report of Forest Administration in Baluchistan for the Year 1926-27. Pp. 28, 9½ × 6½. (Calcutta: Government of India Central Publication Branch, 1928.) Price Rs.3-8 (6s.).

Administration Report on the Forest Department of the Central Provinces, India, of the Year 1926-27. Pp. 41, 9½ × 6½. (Nagpur: Government Press, 1928.) Price Rs.2-2-0.

Report on the Forest Administration of the Central Provinces for

the Year 1926-27. Statements. Pp. 73, 13 × 8. (Nagpur : Government Press, 1928.) Price Rs.6-4-0.

Annual Report on Working Plans and Research in Central Provinces and Berar for the Year 1927-28. Pp. 23, 9½ × 7½. (Nagpur : Government Press, 1928.) Price Rs.1-11-0.

Progress Report on Forest Administration in the Jammu and Kashmir State for the Eighteen Months ending the 16th October, 1927. Pp. 43 + xciii, 9½ × 6½. (Lahore : *Civil and Military Gazette Press*, 1928.)

Annual Report on the Forestry Department, State of North Borneo, for the Year 1926. Pp. 9, 13½ × 8½.

Annual Report on the Forest Department, Sarawak, for the Year 1927. Pp. 8, 13½ × 8½. (Kuching : Government Printing Office, 1928.)

Report on the Forestry Department, Gold Coast, for the Period April 1927-March 1928. Pp. 13, 13½ × 8½. (Accra : Colonial Secretariat, 1928.) Price 1s.

Annual Report, Forest Department, Kenya, for the Year 1927. Pp. 35, 9½ × 6½. (Nairobi : Government Printer, 1928.)

Annual Report of the Forest Administration of Nigeria for the Year 1927. Pp. 32, 14 × 8½. (Lagos : Government Printer, 1928.)

The Seventh Annual Report of the Forest Department, Tanganyika Territory, 1927. Pp. 13, 13 × 8. (Dar es Salaam : Government Printer, 1928.) Price Shs.2/50.

Annual Report on the Forest Department, Uganda, for the Year ended 31st December, 1927. Pp. 16, 13½ × 8½. (Entebbe : Government Printer, Uganda, 1928.) Price Shs. 1/50.

Annual Report of the Department of Forestry, Union of South Africa, for the Year ended 31st March, 1927. Pp. 28, 13 × 8. (Pretoria : Government Printing and Stationery Office, 1928.) Price 2s.

Report on the Forestry Department, British Guiana, for the Year 1927. Pp. 13, 13 × 8½. (Georgetown, Demerara : Government Printer, 1928.)

The Forests of British Guiana. By M. Haman and B. R. Wood. *Tropical Woods* (1928, 15, 1-13).

Administration Report of the Conservator of Forests, Trinidad and Tobago, for the Year 1927. *Council Paper No. 67 of 1928*. Pp. 18, 13½ × 8½. (Port-of-Spain : Government Printing Office, 1928.) Price 8d.

Forests and Forestry in Trinidad and Tobago. By R. C. Marshall. A Statement prepared for the British Empire Forestry Conference, Australia and New Zealand, 1928. Pp. 26, 13½ × 8½. (Port-of-Spain : Government Printer, 1928.)

Report of the Director of Forestry, Canada, for the Year ended March 31, 1927. Pp. 51, 9½ × 6½. (Ottawa : King's Printer, 1928.)

Forestry in Canada. Reprinted from the Canada Year Book, 1927-28. Issued by the Dominion Bureau of Statistics, Canada. Pp. 32, 8½ × 6. (Ottawa : King's Printer, 1928.)

Report of the Forestry Commission, New South Wales, for the Period 1st July, 1926, to 31st December, 1927. Pp. 15, 12½ × 8. (Sydney : Government Printer, 1928.)

Forestry and Forest Resources, Western Australia. A Statement prepared for the British Empire Forestry Conference, 1928. Pp. 28, 13 × 8. (Perth : Government Printer, 1928.)

Annual Report of the Director of Forestry, New Zealand, for the Year ended 31st March, 1928. Pp. 35, 13½ × 8½. (Wellington : Government Printer, 1928.)

The Forests of the Fiji Islands. By J. P. Mead. *Emp. For. Journ.* (1928, 7, 47-54).



The Forest Industry of Finland. By W. E. Hiley. *Oxford Forestry Memoirs*, No. 8, 1928. Pp. 39, 11 × 7½. (Oxford: Clarendon Press, 1928.) Price 4s. 6d.

The National Forests of Colorado. *Misc. Pub. No. 18, U.S. Dept. Agric.* Pp. 38, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 15 cents.

Annual Report of the Director of Forestry of the Philippine Islands for the Fiscal Year ended December 31, 1927. Pp. 263, 9 × 6. (Manila: Bureau of Printing, 1928.)

The Protection Forests of the Mississippi River Watershed and their Part in Flood Prevention. By E. A. Sherman. *Circ. No. 37, U.S. Dept. Agric.* Pp. 49, 9 × 6. (Washington, D.C.: Government Printing Office, 1928.)

Forest Planting Experiments in Minnesota. By T. S. Hansen. *Bull. 238, Minnesota Agric. Exp. Sta.* Pp. 32, 9 × 6. (St. Paul, Minnesota: University of Minnesota, 1927.)

Nursery Investigations. By H. M. Steven. *Bull. No. 11, Forestry Commission.* Pp. 181, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 3s. 6d.

The Foresters' Manual. Parts II, III, IV, and V. *Bull. No. 39, Forest Service, W. Australia.* Pp. 118, 9½ × 6. (Perth: Government Printer, 1927.)

Farm Forestry. IV. The Establishment of Windbreaks, Shelter-Belts, and Tree-lots (cont.). By R. H. Anderson. *Agric. Gaz., N.S.W.* (1928, 39, 478-483; 509-515).

Farm Forestry. V. The Native and Introduced Trees of New South Wales. By R. H. Anderson. *Agric. Gaz., N.S.W.* (1928, 39, 615-626; cont.).

Prevention of Soil Erosion during Re-afforestation in Hilly Sections of the Wet Tropics. By F. A. Stockdale. *Emp. For. Journ.* (1928, 7, 41-46).

Note on Weights of Seeds. By S. H. Howard, revised by H. G. Champion. *For. Bull. No. 41 (Revised), Silviculture Series.* Pp. 21, 9½ × 7½. (Calcutta: Government of India Central Publication Branch, 1928.) Price As.8 (10d.).

Ornamental Trees, Shrubs, and Woody Climbers. By W. J. Macoun. *Bull. No. 89, New Series, Dept. Agric., Canada.* Pp. 52, 9½ × 6½. (Ottawa: King's Printer, 1927.)

Révision des Acacia du Nord, de l'Ouest et du Centre Africain (cont.). By A. Chevalier. *Rev. Bot. App. et d'Agric. Col.* (1928, 8, 496-501; 574-579; 643-650; 707-715).

Descriptions of Fifty New Species and Six Varieties of Western and Northern Australian Acacias and Notes on Four Other Species. By J. H. Maiden and W. F. Blakely. *Bull. No. 41, Forests Dept., W. Australia.* Pp. 36 × 22 plates, 9½ × 6. (Perth: Government Printer, 1928.) Reprinted from *Journ. Roy. Soc., W. Australia*, vol. xiii.

Growth and Yield of Conifers in Great Britain. *Bull. No. 10, Forestry Commission.* Pp. 187, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 4s.

Growing Pine Timber for Profit in the South; Some Examples, Estimates, and Opinions by Lumbermen and Others. *Misc. Pub. No. 24, U.S. Dept. Agric.* Pp. 13, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.) Price 5 cents.

Douglas Fir at Home and Abroad. By J. Kay and M. L. Anderson. *Emp. For. Journ.* (1928, 7, 22-40).

De beschadigingen, ziekten en plagen van de djatiboschen op Java. By L. G. E. Kalshoven. *Tectona* (1928, 21, 593-623). With English Summary.

White Pine Blister Rust. By A. W. McCallum. *Circ. No. 48, Dept. Agric., Canada.* (Ottawa: King's Printer, 1927.)

Black Currant spreads White-Pine Blister Rust. By S. B. Deteviler. *Misc. Pub., No. 27, U.S. Dept. Agric.* Pp. 8, 9 × 6. (Washington, D.C.: U.S. Government Printing Office, 1928.)

A Preliminary Report on the Peridermiums of India and the Occurrence of *Cronartium ribicola* Fisch. on *Ribes rubrum* Linn. By A. Hafiz Khan. *Indian Forester* (1928, **54**, 431-443).

Wood-Charcoal in Southern Rhodesia. By T. L. Wilkinson. *Rhodesia Agric. Journ.* (1928, **25**, 1019-1034).

### Timbers

Timber. Tenth Report of the Imperial Economic Committee (Cmd. 3175). Pp. 52, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 9d. net.

The Uses of Home-Grown Timbers. *For. Prod. Res., Dept. Sci. Indust. Res.* Pp. 36, 9½ × 6. (London: H.M. Stationery Office, 1928.) Price 1s.

Mechanical and Physical Properties of Timbers. Tests of Small Clear Specimens. By C. J. Chaplin. *Project I: For. Prod. Res., Dept. Sci. Indust. Res.* Pp. 57, 9½ × 7½. (London: H.M. Stationery Office, 1928.) Price 2s.

Tests of Some Home-Grown Timbers in their Green Condition. By C. J. Chaplin. *Project I: Progress Report I, For. Prod. Res., Dept. Sci. Indust. Res.* Pp. 9, 9½ × 7½. (London: H.M. Stationery Office, 1928.) Price 9d.

Studies of Some Tropical American Woods. By L. Williams. *Tropical Woods* (1928, **15**, 14-24).

Les Bois d'ébénisterie de la Côte ouest de Madagascar. By H. Perrier de la Bathie. *Rev. Bot. App. et d'Agric. Col.* (1928, **8**, 469-477).

Characteristics, Strength and Durability of Douglas Fir. Pp. 7, 11 × 8½. (Seattle, Washington: West Coast Lumbermen's Association, 1928.)

The Wood Structure of some Species of Kauri (*Agathis* spp.). By M. B. Welch. *Proc. Roy. Soc., New South Wales* (1927, **61**, 248-266).

The Moisture Content of Some Eucalyptus Woods. By M. B. Welch. *Proc. Roy. Soc., New South Wales* (1927, **61**, 296-306).

Some Mechanical Properties of Australian-Grown *Pinus insignis* (*P. radiata*). With Notes on the Wood Structure. By M. B. Welch. *Proc. Roy. Soc., New South Wales* (1927, **61**, 354-370).

Sleeper Woods and Sleeper Supply. By R. G. Marriott. *Emp. For. Journ.* (1928, **7**, 76-83).

The Utilisation and Conversion of Timber, from the Point of View of the Small Landowner. By J. H. Milne Horne. *Trans. Highland and Agric. Soc., Scotland* (1928, **40**, 23-39).

Notes on the Seasoning of Timber. By J. T. McCormick and R. E. Summers. *Munitions Supply Board, Dept. Defence, Australia.* Pp. 53, 9½ × 6. (Melbourne: Government Printer, 1927.)

Dry-Rot in Wood. *Bull. No. 1, For. Prod. Res., Dept. Sci. Indust. Res.* Pp. 24, 9½ × 7½. (London: H.M. Stationery Office, 1928.) Price 1s. 6d.

Wood-Boring Beetles. Their Habits and Control. By W. B. Gurney and T. McCarthy. *Agric. Gaz., N.S.W.* (1928, **39**, 531-537).

### Gums and Resins

Reports of the Committee and of the Director, Indian Lac Research Institute, Nankum, Ranchi, for the Year 1st April, 1927, to 31st March, 1928. Pp. 44, 9½ × 6½. (Calcutta: Star Printing Works, 1928.)

An Experimental Study of the Life Cycles of Lac Insects. Part I. By S. Mahdihassan. Pp. 112, 8½ × 5½. (Madras: Methodist Publishing House, 1927.) Reprinted from *Journ. Sci. Assoc., Maharajah's College, Vizianagaram*, vol. iii, Nos. 2, 3, and 4, 1927.

#### *Tanning Materials*

The Tannin Extract Plant at Crawley, Western Australia. By N. T. M. Wilsmore. *Journ. Coun. Sci. and Indust. Res., Australia* (1928, 1, 285-288).

Bark of *Hopea parviflora* as a Tanning Material. By K. S. Choudary, E. Yoganandam, and N. Arokianathan. *Indian Forester* (1928, 54, 492-495).

La Mangrove malgache es ses produits. By A. Guillaumin. *Agron. Col.* (1928, 17, No. 126, 189-202).

L'exploitation du Palétuvier dans la baie de Manoka (Cameroun). By M. L. Hedin. *Rev. Bot. App. et d'Agric. Col.* (1928, 8, 623-626).

### NOTICES OF RECENT LITERATURE

CHRONICLES OF KENYA. By A. Davis and H. G. Robertson. Pp. 311, 6 × 9. (London: Cecil Palmer, 1928.) Price 7s. 6d. net.

This is not a serious history of Kenya Colony, but, as explained in the Preface, "an attempt to depict Kenya's problems and characteristics in sportive strain." In the words of Sir Edward Northey, who contributes a Foreword, the book consists of "parodies of Kenya life and politics." Sir Edward remarks, however, that "there is truth and instruction to be gleaned from these pages" and recommends the volume to all interested in the Colony. It is a genuinely humorous book and should find many appreciative readers.

AN ECONOMIC AND FINANCIAL ANALYSIS OF FIFTEEN EAST ANGLIAN FARMS, 1926-27. By R. McG. Carslaw, M.A., and W. H. Kirkpatrick, C.D.A. University of Cambridge, Department of Agriculture, Farm Economics Branch Report No. 10. Pp. 17, 9½ × 7½. (Cambridge: W. Heffer & Sons, Ltd., 1928.) Price 1s.

The object of the investigation recorded in this report was to obtain some idea of the agricultural conditions at present prevailing in the Eastern Counties. The enquiry is one of a series of annual investigations preliminary to a comprehensive Report covering a period of four years. The report, like its predecessors, is based on a complete system of cost for each individual farm analysed. Tables are given showing full details, each item of cost and each crop return being considered separately. The authors

conclude from their analyses that, for this part of the country, the season 1926-27 was the worst since the disastrous fall in values in 1920-22.

**FARM BUILDINGS.** By W. A. Foster, B.Sci. in Edu., B.Arch., A.E., and Dean G. Carter, B.S. in A.E., M.S. Pp. xviii + 358, 8 × 5½. Second edition. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1928.) Price 15s.

This book deals with the location, planning, construction and repair of farm buildings. It is intended primarily as a textbook for agricultural students and in this edition the text has been rearranged to present the subject matter in a more logical teaching order. New facts, materials and methods have been included and many chapters have been entirely rewritten.

The first two chapters of the book deal with general principles of the planning of farm buildings. The various materials employed in building, such as woods, metal, cement and concrete, are then considered, and a discussion is given of cost estimating.

The main part of the book deals with the construction of farm buildings such as those used for various kinds of livestock, silos and barns. Space is devoted to a consideration of the planning of the farmhouse itself, its building, specifications and detailed inner construction. There is a useful list of books, periodicals, etc., containing information on farm buildings.

**FARM MACHINERY.** By Archibald A. Stone. Pp. xii + 466, 8 × 5½. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1928.) Price 15s.

This book, which is copiously illustrated, is intended for American students of "vocational agriculture," and should do much to give them a useful understanding of the implements and machines with which they will have to become familiar, and to increase the facility with which they will be able to carry out necessary adjustments and repairs.

**FEEDING STUFFS.** By Arthur S. Carlos, B.Sc., F.I.C. Pp. xi + 152, 7 × 4½. (London: Chapman & Hall, Ltd., 1928.) Price 5s.

In the Foreword the author states that the book is intended, not only for farmers, chemists and students, but also for those engaged in the handling of feeding stuffs in factories, offices, corn exchanges and markets,

and that it has therefore been written in a simple form, technicalities being avoided wherever possible.

In the first chapter the chemical composition of feeding stuffs is discussed, and the properties and functions of the various components (fat, proteins, carbohydrates, etc.) are described. Other chapters deal with grains and seeds, oil-cakes and meals and their manufacture, animal products employed in cattle foods, sundry feeding stuffs (such as cocoa shell, molasses and spent yeast), and the methods of preparing compound foods. In connection with each product mentioned, reference is made to its composition, country of origin, method of production or manufacture, and uses. Information is supplied on comparative food values, food units and starch equivalents, and on the rations required by various animals. A summary is provided of the Fertilisers and Feeding Stuffs Act, 1926, together with the Regulations of 1928. In the final chapter a brief statement is made regarding the principal feeding stuffs used in India and the British Dominions.

The work contains a number of illustrations of plant and machinery and two appendixes, the first consisting of statistics of the trade in feeding stuffs in the principal countries of the world, and the other of tables of analyses and nutritive values. The book has been carefully written and should serve a useful purpose.

SUGAR BEET IN THE EASTERN COUNTIES, 1927. By R. McG. Carslaw, M.A., C. Burgess, B.A., and G. Ll. Rogers, M.A., with a Foreword by J. A. Venn, M.A. University of Cambridge, Department of Agriculture, Farm Economics Branch Report No. 9. Pp. xii + 94, 9½ × 7½. (Cambridge: W. Heffer & Sons, Ltd., 1928.) Price 3s.

This work gives the results of a study of the 1927 sugar beet crop in the Eastern and North-Eastern Divisions of England. The investigations cover a hundred farms, and an attempt is made to give a broad survey of the situation both from the economic and the cultural point of view.

The subjects dealt with include field data, such as manuring, yields, sugar content, etc., the influence of time of delivery on sugar content, the weather conditions during the period under review, haulage and transport, estimations of costs and returns, controllable influences, such as manuring, rate of seeding, spacing, etc., and also such questions as casual labour and implements.

Complete data are given respecting the soil, rent,

labour supply, etc., of each farm ; cultivation particulars for each field ; manuring and yield data ; field costs and returns per acre and per ton of washed beets ; as well as the farmers' comments on the growth conditions and on the value of beet tops for feeding purposes.

The detailed particulars given should be of great value to beet growers as a guide to their possible returns in future years, while the report will be read with interest by landowners, sugar manufacturers and others concerned with sugar beet production.

FATS AND OILS STUDIES OF THE FOOD RESEARCH INSTITUTE, STANFORD UNIVERSITY, CALIFORNIA.—No. 1, February, 1928. THE FATS AND OILS—A GENERAL VIEW. By Carl O. Alsberg and Alonzo E. Taylor. Pp. viii + 103,  $8\frac{1}{2} \times 5\frac{1}{4}$ . Price 4s.—No. 2, April 1928. COPRA AND COCONUT OIL. By Katharine Snodgrass. Pp. xiii + 135,  $8\frac{1}{2} \times 5\frac{1}{4}$ . Price 6s. (London : P. S. King & Son, Ltd.)

In the Preface to this series it is stated that the considerations which have led the Food Research Institute to begin publication of a series of Fats and Oils Studies are the growth of international trade and the increasing substitution of one fat for another in response to changes in consumers' preferences and manufacturers' technique, which have given rise to serious problems of public policy, especially with respect to food laws and tariff restrictions. An additional consideration is that the literature dealing with fats and oils is notably deficient in its economic and statistical aspects.

In these volumes emphasis is placed on the economic phases of the trade, and on the uses of the fats for food rather than for industrial purposes, though due consideration is given to scientific knowledge relevant to the latter. The principal aim of the series is to develop an increased understanding out of which sound views on questions of public policy and business practice may be evolved.

No. 1 is presented as " a simple, elementary and non-technical exposition of the production, the technology and the interrelations of the various fats and oils, which may serve as a background for the more specialised studies that follow." It is also stated in the Preface that nearly all the material can be found in one or another of the many existing handbooks, but that nowhere has the information desirable for an understanding of the fat and oil trade as it affects agriculture and industry been previously collected in a form so simple as to be intelligible to those without

technical training. A description is given of the nature, sources and properties of fats and oils ; their technology ; the conditions and trends of their production and consumption, and with the international trade in them. Statistical tables are included dealing *inter alia* with the consumption of oils and fats ; the production of oleo-margarine ; and the consumption of these materials in the manufacture of margarine in the United States.

In the second volume of the series information is given on the cultivation of the coconut palm and the preparation of coconut products ; the world's output of copra and coconut oil, and the production in various individual countries. Other subjects dealt with include the international trade in coconut products, its volume and course, and shipping and tariff conditions ; the utilisation of coconut oil in the margarine and soap industries, and its market position and outlook. The book is furnished with charts and tables which show in a condensed form the industrial importance of coconut oil.

Both volumes are comprehensive in character and are written in clear and simple language, suitable for the non-technical reader.

STUDIES OF QUALITY IN COTTON. By W. Lawrence Balls, Sc.D., F.R.S. Pp. xxvii + 376, 8 $\frac{1}{2}$  × 5 $\frac{1}{4}$ . (London : Macmillan & Co. Ltd., 1928.) Price 20s.

The author of this treatise is well known as an expert in cotton-growing and cotton genetics, especially in relation to Egyptian conditions ; but the present volume is based mainly on his experience as Chief of the Experimental Department of the Fine Cotton Spinners' and Doublers' Association from 1915 to 1925. The work is divided into three main parts, entitled " The Cotton," " The Yarn " and " Cotton Growing for Quality," and includes an Appendix " On the Technique of Industrial Research." Many illustrations and diagrams are furnished, the book is well printed and produced, and the author's style is not unattractive although inclined to be a little verbose ; but the treatise is not likely to be of special interest except to those actually engaged in the detailed study of cotton technology on scientific lines.

In the Preface and Introduction Dr. Balls characterises the book as an " ambitious attempt," and one chapter of it as " frankly a premature attempt to generalise among a miscellany of information." It may be described as a discursive account of laboratory determinations mingled with disquisitions on the development of cotton technology,

and as such it may stimulate further work in a highly specialised branch of research.

**LONG VEGETABLE FIBRES.** By F. I. Oakley, Lecturer on Long Vegetable Fibres at the City of London College. Pp. 176,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: Ernest Benn, Limited, 1928.) Price 10s. 6d.

The object of this book is to supply such information to the merchant, spinner and textile student as will enable them to obtain a general working knowledge of the various long vegetable fibres which they may be called upon to handle.

Questions of the climatic and soil conditions required for the different fibre plants and the methods of cultivation receive comparatively little attention, it being considered that such matters are of minor importance to those for whom the work is intended. The author remarks in his Preface that "A little botanical knowledge should be of service," but it is unfortunate that such botanical particulars as he has given are marred by serious inaccuracies. Bengal jute is said to be derived from *Crotalaria* spp. (instead of *Corchorus*) and many of the botanical names are misspelt, e.g. *Crotalaria* is invariably spelt *Crotolaria*, and *Cocos* as *Cocus*, whilst Mauritius hemp is said to be extracted from *Agave Foucrœa gigantea*.

A remarkable mistake occurs on p. 142, where it is said that Sisal hemp (as compared with Manila hemp) "has the great advantage that it does not readily absorb water and so weighs very little more when wet than in a dry condition." This is directly contrary to general experience.

The principal information given in the book relates to the marketing of the fibres and contains details of the various grades and the marks by which they are distinguished, as well as particulars of the rules governing commercial contracts and the regulations regarding arbitrations, etc. So far as we are aware this information has not previously been published in a collected form.

**THE ROMANCE OF JUTE.** A Short History of the Calcutta Jute Mill Industry: 1855-1927. By D. R. Wallace. Second edition. Pp. xiv + 129,  $7\frac{1}{2} \times 4\frac{1}{2}$ . (London: W. Thacker & Co.; Calcutta and Simla: Thacker, Spink & Co., 1928.) Price 7s. 6d.

In this new edition of Mr. Wallace's interesting little work the history of the jute manufacturing industry of India is brought up to the year 1927. The book records



the progress made from 1855, when the first spinning machinery was introduced into Calcutta from Dundee, and shows the remarkable manner in which development has taken place. The first mill to be erected had an output of 8 tons a day, whereas there are now 84 mills producing over 4,800 tons of fabrics daily. The expansion of both the domestic and foreign trade is traced, and the vicissitudes the industry has experienced and the difficulties that have been surmounted are described in an interesting manner.

There are appendixes giving the number of looms and spindles at different periods of the industry, a complete list of the Calcutta jute mills in 1927, statistics of exports from India of raw jute and manufactured articles, a list of the firms composing the Indian Jute Mills Association, a glossary of jute trade terms, and a short account of the cultivation and preparation of the fibre. The book is well illustrated and is provided with a map of the River Hooghly showing the location of the various jute mills in 1928.

LES HIBISCUS (KETMIE), CULTURE ET EXPLOITATION. By F. Michotte. Pp. 100, 9½ × 6. (Paris: Société Propagande Coloniale, 1928.) Price 15 francs.

In a Preface to this work the author draws attention to the cultural advantages of *Hibiscus* over the jute plant. He points out that whereas jute is especially adapted to the climatic and labour conditions prevailing in India, *Hibiscus*, by virtue of its many species and varieties, can be grown successfully in many parts of the world.

The first portion of the book deals with the botanical descriptions of different species and varieties of *Hibiscus*, and their habitats. The designations are stated to be those occurring in the Index Kewensis, but a number of errors and misspellings are present. Mention is made of many of the diseases to which *Hibiscus* is subject, and the means of combating them. A large portion of the book deals with the countries throughout the world where species of *Hibiscus* are grown, and records the extent to which the plants of this genus are employed for the production of fibre. The statistics given, however, are in many cases by no means up to date. For instance, the latest figures given for the total export of *H. cannabinus* fibre ("Bimlipatam jute") from India are those of twenty years ago. Mention is also made of other uses to which various species of *Hibiscus* are put, such as the employment of the fruits, flowers and leaves in foods and for the preparation of beverages, of the stems and roots for the manufacture of

paper, and of the seeds for the extraction of an edible oil, the characters of which are described. The third section of the book is devoted to the culture of the different species, details being given as to the soil, climatic conditions and manures most suitable for their successful growth. Although the genus is indigenous in tropical zones, some of the species can be acclimatised in the subtropics, and a few in temperate climates. The information given, however, especially applies to the commercial species: *H. cannabinus*, the principal species employed for the production of fibre; *H. sabdariffa*, also used as a source of fibre, and for the preparation of jam or jelly from its fleshy calyx; and *H. esculentus*, utilised chiefly for its edible fruits.

The remainder of the treatise is concerned with the extraction and preparation of the fibre, its properties and uses. After describing the general method of preparation, which is similar to that of jute, reference is made to several mechanical decorticators which have been devised for the extraction of the fibre. According to the author the only machine which has proved of any value is one invented by himself. This is stated to be capable of producing 300 kilograms of dry fibre a day. He, however, refers earlier in the book to the results of a practical trial made with this machine in French West Africa, in consequence of which the machine was pronounced to be worthless.

The present work forms a useful compendium of information concerning the culture, world production and commercial uses of the genus *Hibiscus*, and should prove of value in connection with the exploitation of these important fibre-yielding plants.

LES VERS À SOIE SAUVAGES DU CONGO BELGE. By Émile Michel. Pp. 41,  $9\frac{1}{2} \times 6\frac{1}{4}$ . (Brussels: Imprimerie Industrielle et Financière, Soc. Anon., 1928.) Price 10 francs.

This little book provides a useful summary of information regarding the "wild" silks of the Belgian Congo derived from moths belonging to the genus *Anaphe* and its allies. *Anaphe* silk obtained from British countries in tropical Africa (Nigeria, Uganda and East Africa) has been the subject of much investigation at the Imperial Institute and accounts of the work done have been published in this BULLETIN (see chiefly 1916, 14, 167; 1920, 18, 219).

The question of the industrial use of the raw material in this country as a source of "waste" silk is still a subject of enquiry and the summary of information prepared

by M. Michel will be found helpful to those engaged in the work. The species of insects occurring in the Belgian Congo include those found in British territories, and the three species most widely distributed are also among the most important British species, namely, *Anaphe panda* Bdv. var. *infracta* Wals., *A. venata* Butl. and *Epanaphe Moloneyi* the last-mentioned moth being also well known as *Anaphe Moloneyi*. In all, some six species and varieties of *Anaphe* and six species of *Epanaphe* have been described from the Belgian Congo.

The moths of the three principal species are described in detail and a full account of their geographical distribution in the Congo is given. The larvæ of the moths feed upon the leaves of a variety of woody plants. Those of *A. panda* var. *infracta* prefer certain species of *Bridelia*, especially *B. micrantha* Baill., while *A. venata* feeds on species of *Albizzia* (e.g. *A. fastigiata* Oliv.) and *Sterculia* (e.g. *S. tragacantha* Lindl.). The food plants of *Epanaphe Moloneyi* are *Albizzia fastigiata* Oliv. and *A. intermedia* De Wild. et Th. Dur. It may be mentioned that in Uganda *A. panda* var. *infracta* feeds chiefly on *Bridelia ferruginea* Benth. and also on *Cynometra alexandri* Wright and *Triumfetta macrophylla* K. Schum; the first-mentioned tree is also a food plant in the Congo and the second occurs in the country, but the *Triumfetta* has not yet been recorded there. An account of the distribution of the food plants of all the species is given so far as known.

A useful chapter is devoted to a description of the "nests" of the different species of worm, and for his information the author has drawn largely upon the published work of Mr. A. W. J. Pomeroy. The complex nature of the sac-like nest of *A. panda* var. *infracta* is carefully described, but the account of the *Epanaphe* nests does not, perhaps, make it clear that the sac-like form of nest does not occur in this species. The chapter is followed by an account of the insect and other enemies of *Anaphe* compiled from the work of Gowdey, Pomeroy and Waterston, while Pomeroy's observations regarding the urticating hairs associated with the moths are also described. The author deals with the practical difficulties likely to be encountered in an endeavour to collect wild *Anaphe* nests in commercial quantities for export and refers to the proposals which have been made to raise the nests in special plantations of the food plants, notably *Bridelia*. The book contains a series of nineteen illustrations, nearly all of which were originally published in this BULLETIN ("The Irritating Hairs of the Wild Silk Moths of Nigeria," by A. W. J. Pomeroy, 1921, 19, 311).

**ARTIFICIAL SILK.** By Ing. Dr. Franz Reinthaler. Enlarged and revised edition, translated from the German by F. M. Rowe, D.Sc., F.I.C. Pp. xii + 276, 8 $\frac{1}{2}$  × 5 $\frac{1}{2}$ . (London : Chapman & Hall, Ltd., 1928.) Price 21s.

This book is essentially a translation of Professor Reinthaler's *Die Kunstseide und andere seidenglänzende Fasern*, but it has been considerably revised and enlarged, the introduction of new matter having increased the contents by about 30–40 per cent. The order of the chapters has been rearranged and many new illustrations have been added. During the progress of his work the translator has had the benefit of Professor Reinthaler's close co-operation. Throughout the book numerous references are given to patent literature and other publications where further information on various aspects of the subject may be found.

After a discussion of the properties of cellulose and its behaviour when subjected to heat and to the action of various chemical reagents, the different processes for the preparation of artificial silks are described and information is given regarding their characters and properties. One chapter is devoted to the methods of examination and testing of artificial silks and another deals with the dyeing of the materials. Reference is also made to the manufacture of artificial horsehair, artificial silk ribbons and tapes, and the preparation of fabrics directly from artificial silk spinning solutions without the intermediate production of threads.

An account is given of the uses of artificial silk, including its combination with other fibres for the production of mixed fabrics. The economic situation of the industry is briefly surveyed and particulars are furnished of costs of production and prices of artificial silks, together with figures of production and consumption.

The book is written in a clear and easily comprehensible style and is well illustrated. It deals with the subject throughout from the practical standpoint, and can be thoroughly recommended.

**LE CAOUTCHOUC : ÉTUDE ÉCONOMIQUE ET STATISTIQUE.** By José Carlos de Macedo Soares. Pp. 160, 9 × 5 $\frac{1}{2}$ . (Paris : A.-D. Gillard, 1928.) Price 22 francs.

This work appeared last year in Portuguese, and the editor of *Le Caoutchouc et la Gutta Percha* arranged for the issue of the present French edition so that it should be accessible to a larger number of readers.

A short introduction gives the author's views on the

functions of the State in economic questions and on recent developments of Government control, with special reference to the regulation of the supplies of raw rubber in the British Empire.

The first half of the book contains an account of the development of the raw rubber industry, the decline of Brazil following the rapid increase of the plantations in the Middle East, and the economic factors leading to the appointment of the Stevenson Committee. A detailed description of the machinery of the rubber restriction scheme is included. Many tables of interesting statistics are published in this section, but they terminate in most cases with 1926 and are consequently of no special interest in this country, where later information on the same subjects has already been widely published.

The remainder of the book deals principally with the importance of the production of rubber in Brazil as a source of supply for the American markets.

LES PLANTES À PARFUMS DES COLONIES FRANÇAISES. By Elie Maunier. Pp. 134,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (Marseilles: Institut Colonial, 1928.) Price 12 francs.

This useful and instructive work deals in a comprehensive manner with the production of essential oils and associated products in French colonies. Each colony is considered in detail as regards its resources in these materials; particulars are given of the quantities produced or exported, and the prospects of further development are discussed. General information is given concerning the economic possibilities of each colony as influenced by its geographical situation, soil, climate, labour conditions and other considerations.

It is mentioned in the introduction to the work that in 1926 the perfumery trade of France consumed more than 15,000 quintals of essential oils from foreign sources, valued at over 153 million francs. The book has therefore been written largely with a view to stimulating production in French possessions of those oils for which France is at present dependent on foreign countries.

THE CELLULOSE LACQUERS. A Practical Handbook on their Manufacture. By Stanley Smith, O.B.E., Ph.D. Pp. ix + 145,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London: Sir Isaac Pitman & Sons, Ltd., 1928.) Price 7s. 6d.

The comparatively new industry connected with the manufacture and utilisation of cellulose lacquers is of growing importance and a handbook on the subject was

greatly needed. The present work, which is based on a course of lectures delivered by the author at the Borough Polytechnic Institute, London, will therefore be warmly welcomed by students and workers in this branch of technology.

The raw materials of the industry, including the cellulose nitrates, resins, solvents, diluents and plasticisers, are described, and the characters which render them of special service for cellulose lacquers are pointed out, together with the limitations of their application in each case. The reasons underlying the choice of particular materials of each class for combination into a lacquer are carefully explained and the properties which should be realised in the finished lacquer are clearly indicated. A short account is given of the plant and machinery required for the equipment of a cellulose lacquer factory, and information is supplied regarding the designing of formulæ and the methods of mixing the ingredients. A useful chapter is devoted to the pigments used in the industry, and, in view of the importance of humidity conditions to the satisfactory preparation and application of the lacquers, another chapter deals with the subject of hygrometry. The work concludes with a description of the methods of applying the lacquers and of the various purposes for which they may be used.

The work is written in an easy and lucid style, is well illustrated and can be thoroughly recommended to all who are interested in the production or utilisation of the highly decorative lacquers and finishes with which it deals.

**SILVICULTURAL SYSTEMS.** By R. S. Troup, C.I.E., D.Sc., F.R.S. Pp. xii + 199, 9½ × 6½. (Oxford: The Clarendon Press, 1928.) Price 21s.

This important volume, which will at once take its place as a standard work in forestry literature, is the first of a series of manuals dealing with different branches of forestry which it is proposed to issue from time to time from Oxford. Apart from the question of afforestation, the safeguarding of timber supplies in commercial quantities depends first of all upon the protection and conservation of existing forest areas to the fullest extent possible; but these measures will be found inadequate in the absence of the scientific treatment of the available forest area with the object of producing "the highest possible sustained yield of suitable timber compatible with economic and other considerations." This latter subject, while a comparatively new one in most British

countries, has received careful study through very long periods in certain Continental countries and, as a result of the experience gained, there have been evolved systems of dealing with the forests—silvicultural systems—which stand as models for foresters throughout the world. In view of the anxiety which is being felt in most countries of the Empire in relation to supplies of forest trees and timber, and of the attention directed towards improving the present position as regards these supplies, it is of great importance that those in charge of the work now being undertaken should be acquainted with the invaluable experience already gained in Europe. Hitherto, there has not been available, in English, a comprehensive work on silvicultural systems, and it is to supply this need that the present volume has been written. It is clear that no more appropriate subject could have been chosen for the first volume of the series of works to which reference has been made above.

In his preface Professor Troup deals with the not unlikely comment that while the experience of Continental foresters will no doubt be directly applicable to problems in this country, the cultural systems perfected in Europe will not be successfully applied to other parts of the world (especially in the tropics) where entirely different circumstances obtain. The author is in a position to disarm this criticism at first hand and from his own personal experience, since he points out that for more than half a century the silvicultural systems of Europe, with modifications naturally suggested by local circumstances, have been adopted with success in many parts of India varying in their natural conditions and types of forest, and he remarks that the great progress which has been made in forestry in India during the last fifty years has been due in large measure to the fact that the officers of the higher branches of the Forest Service have received their practical training in the forests of Continental Europe. From a consideration of the subject matter of the present work it would seem that the position is that centuries of study of forest problems in Germany, France and other Continental countries has resulted in the discovery of many of the fundamental principles of silvicultural work; a knowledge of these principles, which should result from a close consideration of European systems, should permit of their adoption in other countries with such modifications as would be suggested by local conditions.

The book, although of intense interest, is not light reading and bears testimony to the author's knowledge of

his subject. The descriptions of the various systems and the discussions on them have been based, as far as possible, on the results of personal investigations of the author extending over a number of years in the forests of several European countries, and the many beautiful photographs which add much to the interest and clarity of the book have been taken by the author himself. There are nineteen sections or chapters which deal with some fifteen silvicultural systems. In each case a general explanation of the system has been given and important principles are illustrated by reference to actual examples. The original technical language of silvicultural systems is necessarily French or German, and, while Professor Troup employs an admirable English terminology throughout, not the least valuable feature of each chapter is the introductory elucidation of the often difficult Continental terminology which has been evolved. The author desires that the book should be regarded as "a guide towards the practical study of systems in the forest"; there is no doubt that foresters throughout English-speaking countries will readily avail themselves of its services.

AERIAL SURVEY IN RELATION TO THE ECONOMIC DEVELOPMENT OF NEW COUNTRIES, WITH SPECIAL REFERENCE TO AN INVESTIGATION CARRIED OUT IN NORTHERN RHODESIA. By R. Bourne, M.A. Oxford Forestry Memoirs, No. 9, 1928. Pp. 35,  $10\frac{3}{4} \times 7\frac{1}{2}$ . (Oxford: The Clarendon Press, 1928.) Price 7s. 6d.

The possibilities of the aeroplane in the service of forestry formed the subject of a note in this BULLETIN (1926, 28, 492) based on a Report by the Burma Forest Department. Experimental work on the subject has also been carried out in other countries; improvements in technique are rapidly being made; and aerial surveying can now be said to have emerged from the pioneer period to a stage at which its possibilities and limitations can be examined on broader lines.

Such a review is attempted in the present publication. A particular aerial survey undertaken in Northern Rhodesia is considered in some detail, especially as regards the data necessary for its planning, the question of co-operation between air surveyor and field workers, the methods of working adopted, the correlation of the results obtained, and, not least, the cost of obtaining them.

From a study of the question under the particular conditions prevailing in Northern Rhodesia the author proceeds to a general consideration of aerial reconnaissance as an instrument of economic progress. He urges the



extent to which the knowledge of vegetation and topography, that is now rendered more quickly attainable, will facilitate the co-ordination of facts collected by agriculturists, foresters and geologists, such as have in the past formed the basis for plans often put forward independently by such specialists ; and he has hopes that this will lead to a better perspective in viewing problems of Empire development as a whole.

DRY-ROT IN WOOD. Pp. vi + 24,  $9\frac{1}{2} \times 7\frac{1}{4}$ . Department of Scientific and Industrial Research, Forest Products Research, *Bulletin* No. 1. (London : His Majesty's Stationery Office, 1928.) Price 1s. 6d.

Mr. R. S. Pearson, Director of Forest Products Research, in a prefatory note to this *Bulletin*, points out that there is ample evidence of the need for wide dissemination of information which may assist towards reducing dry-rot, which is the cause not only of a very large wastage but of many serious accidents. The purposes of the *Bulletin* are to present in a simple and practical form a summary of existing knowledge of the subject, to assist recognition of the signs of the disease, and to provide authoritative information concerning its prevention and remedy. The first part, which deals with the biology of fungi causing dry-rot, has been written by Professor Percy Groom, F.R.S. ; Part II, on the detection and practical treatment of dry-rot, has been contributed by H.M. Office of Works, with assistance, as regards the section on preservatives, from Professor Groom and the Forests Products Research Laboratory ; while Part III, which describes the precautions to be taken in the use of timber in new buildings to prevent outbreaks of dry-rot, has been contributed by the Building Research Station of the Department of Scientific and Industrial Research.

The Forest Products Research Laboratory have performed a most useful service in gathering together such authoritative statements on the different aspects of the subject and the *Bulletin* can be thoroughly recommended to all interested in the use of timber for building construction.

THE USES OF HOME-GROWN TIMBERS. Pp. vi + 36,  $9\frac{1}{2} \times 6$ . Department of Scientific and Industrial Research, Forest Products Research. (London : His Majesty's Stationery Office, 1928.) Price 1s.

This publication gives the preliminary results of an enquiry into the uses of home-grown timbers which is

being undertaken by a Committee, set up by the Land Agents' Society, and consisting of representatives of that Society, the Federated Home-grown Timber Merchants' Association, the Royal Institute of British Architects, and the Forest Products Research Laboratory. A brief description of each wood is given, followed, in most cases, by a schedule showing the purposes for which the wood is employed, with an indication of the relative extent to which home-grown and imported timber is used for each purpose and also the relative suitability of British and foreign wood.

TESTS OF SOME HOME-GROWN TIMBERS IN THEIR GREEN CONDITION. By C. J. Chaplin, M.Sc., M.E.I.C. Department of Scientific and Industrial Research, Forest Products Research, Project 1: Progress Report 1. Pp. iv + 9, 9½ × 7½. (London: His Majesty's Stationery Office, 1928.) Price 9d.

Very little reliable information has been available hitherto on the mechanical properties of British-grown timbers, and the majority of the results published have been of small value as an indication of the strength of a species and useless for purposes of comparison with other species, owing to the variation in the methods of testing employed, the insufficient number of tests carried out and the absence, in many cases, of data relating to the condition of seasoning of the timber tested.

The Forest Products Research Laboratory publish in their first Progress Report strength values for five British-grown timbers tested in the green condition under standard methods, which will allow their comparison with the timbers of other countries where these methods have been adopted.

The report consists of an introduction, a brief description of the methods of testing, a table giving particulars of the trees and their locations, information relating to the tests, and results and conclusions arrived at from the strength values obtained for the timbers. The mechanical and physical properties are fully tabulated in an appendix together with a diagram comparing the results by species. The woods tested were ash (*Fraxinus excelsior*) from Coleford, Gloucester; Douglas fir (*Pseudotsuga Douglasii*) from Taymount, Scotland; European larch (*Larix europæa*) from Forest of Dean, Gloucester; Corsican pine (*Pinus laricio*) from Wells, Norfolk; and Scots pine (*Pinus sylvestris*) from Bedgebury, Kent.

The desirability of obtaining, as early as possible, some indication of the strengths of these timbers necessitated

testing initially single consignments of five or more representative trees; the results, therefore, apply to the particular locality in which collection was made, but must not be regarded as the average figures for the species throughout the country.

**TESTS OF SMALL CLEAR SPECIMENS.** By C. J. Chaplin, M.Sc., M.E.I.C. Department of Scientific and Industrial Research, Forest Products Research, Project 1: Mechanical and Physical Properties of Timbers. (London: His Majesty's Stationery Office, 1928.) Price 2s.

In this publication is given a detailed description of the methods employed by the Forest Products Research Laboratory in the determination of the mechanical and physical properties of home-grown and imported timbers.

The methods adopted closely follow the standardised specifications of the Forest Products Research Laboratories of the United States of America, Canada and India, in order to obtain direct comparison of results. A few alterations have been made with a view to obtaining increased reliability in the data, but these do not affect comparison values.

The work contains an introduction, information on the collection and subsequent disposal of the timber to be tested, complete descriptions of the mechanical tests and of the physical tests, and notes on records and on photographs. In four appendixes are given the necessary formulæ and methods of computing, a glossary of terms, a list of testing machines, and facsimiles of the forms and cards used in recording data. Fifteen excellent illustrations are provided, showing the methods of cutting the timber, the dimensions of the test-pieces and the forms of apparatus employed in the various tests.

**AN INTRODUCTION TO THE CHEMISTRY OF PLANT PRODUCTS.** Volume 1.—ON THE NATURE AND SIGNIFICANCE OF THE COMMONER ORGANIC COMPOUNDS OF PLANTS. By P. Haas and T. G. Hill. Fourth edition. Pp. xvi + 530. (London: Longmans, Green & Co., 1928.) Price 18s. net.

The very extensive literature on biochemistry which has appeared since the third edition of this work was published in 1920 (see this BULLETIN, 1920, 18, 570), has necessitated much revision and the authors state in their Preface that, in the main, the present edition has been rewritten.

The subject-matter of this volume is dealt with under the following heads: fats, oils and waxes; aldehydes and

alcohols ; carbohydrates ; glucosides ; tannins ; pigments ; nitrogen bases ; proteins ; and enzymes. There is also a section dealing with the colloidal state and a brief appendix on hydrogen-ion concentration.

The general scheme followed in the case of each product is to describe the occurrence of the particular class of substances, their isolation, classification, general properties and reactions, and finally their physiological significance in plant life. Methods of estimation and analysis are given and, where possible, mention is made of the industrial uses of plants and plant products and of the manufacturing processes connected with them. The inclusion of an author index in addition to the subject index would be a distinct advantage.

✓ **THE CHEMISTRY OF CRUDE DRUGS.** An Elementary Textbook for Students of Pharmacognosy. By John Edmund Driver, M.Sc., Ph.D., A.I.C., and George Edward Trease, Ph.C. Pp. vii + 159,  $8\frac{1}{2} \times 5\frac{1}{2}$ . (London : Longmans, Green & Co., Ltd., 1928.) Price 10s. 6d.

In this volume the more important substances present in crude drugs are dealt with under a classification that is mainly chemical, in contrast to that used in the ordinary books of materia medica which is based on the morphological characters of the drugs. A number of simple chemical tests and practical exercises for the student are given.

The authors have undertaken a difficult task in preparing a book of this kind for readers with " no more than an elementary knowledge of organic chemistry," and it is probable that in order to obtain an intelligent grasp of the subject such students will find it necessary to extend their reading outside the limits of this book.

A portion of the introduction deals with enzymes in their relation to drugs ; and the last three pages of the book, devoted to vitamins, are worthy of mention, as giving a maximum amount of information on these substances in a minimum of space.

**COLLOID CHEMISTRY.** By The Svedberg. Second edition, revised and enlarged in collaboration with Arne Tiselius. American Chemical Society Monograph Series No. 16. Pp. 302,  $9\frac{1}{4} \times 6\frac{1}{4}$ . (New York : The Chemical Catalog Company, Inc., 1928.) Price \$5.50.

This book gives an excellent general survey of colloid chemistry, with detailed descriptions of work in the author's own laboratory. An historical introduction defines the chief problem of colloid chemistry as the investigation of

the structure of colloid systems. The study of the systems, arranged in terms of the colloid "particle," is divided into four parts: I. The formation of the particle; II. The particle as a molecular kinetic unit; III. The particle as a micell; and IV. The ageing and destruction of the particle. The fourth part, however, consists only of three short paragraphs which serve to call attention to the need for work on the ageing and breaking up of colloid systems.

The original edition, published in 1923, was based on a series of lectures given at the University of Wisconsin. Since that date much advance has been made in the study of colloid chemistry. The application of X-ray analysis to the study of sols and gels has proved of fundamental importance in the elucidation of the structure of the colloid particle, and more space is therefore given in the new edition to the discussion and demonstration of the X-ray method and the results attained by it. Other subjects which receive special attention in this edition include improvements in the technique of ultramicroscopy, in the measurement of diffusion and cataphoresis, and in particular Svedberg's new methods of colloid analysis by means of the ultracentrifuge.

**DAIRY CATTLE FEEDING AND MANAGEMENT.** By Carl W. Larson, M.S.A., Ph.D., and Fred S. Putney, M.S.A. Second edition, revised by H. O. Henderson, M.S.A. Pp. xxiii + 450, 9 × 6. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1928.) Price 20s.

This work, compiled by American dairying experts, is primarily intended as a course of lectures for students, but it forms a comprehensive and well-written treatise which should be useful, as the author suggests, to practical dairymen, herdsmen, teachers and others concerned with dairy cattle and their management. Food-stuffs, pasture, breeding, cattle diseases, milk production and marketing, cost accounts and other important aspects of the subject are clearly and practically dealt with, and the utility of the volume is increased by the inclusion of numerous illustrations, tables and bibliographies.

**THE SOILS OF CUBA.** By Hugh H. Bennett and Robert V. Allison. Pp. xxiv + 410, 9 × 6, with Coloured Soil Map of Cuba and the Isle of Pines, 25 × 60, and key to the soils, in separate portfolio. (Washington, D.C.: Tropical Plant Research Foundation, 1928.) Price \$6.25.

This book presents the results of one of the first comprehensive soil surveys that has yet been made of a large area within the tropics according to modern methods of

studying and classifying soils. The work on which it is based has been done by the Tropical Plant Research Foundation in co-operation with the U.S. Department of Agriculture.

The original object of the work was to secure information for the guidance of the Foundation in locating experimental fields and in planning and conducting investigations on the production of sugar cane and to increase exact knowledge of the soils of the tropics. Sugar cane is so far the predominant crop grown in Cuba that variations in the soil can be considered in relation to this single crop.

The book defines all the important soils of Cuba, giving the leading physical and chemical characteristics of surface and subsoil layers, salt content and drainage conditions. The crop adaptations, fertiliser needs and cultural requirements of each soil type are discussed in detail, with particular emphasis on the relationships of the different types to the production of sugar cane.

The soils are very carefully classified into families, series and types, the type forming the unit of soil mapping. The distribution of the various series and types is very clearly shown in the large coloured soil map.

The book contains a chapter by Dr. C. F. Marbut, of the U.S. Department of Agriculture, on the general principles of soil classification.

Although the cultivation of sugar cane naturally occupies the greater part of the book, information is also given on the subsidiary agricultural industries of Cuba, particularly the growing of cigar-tobacco.

It is unfortunate from the point of view of the usefulness of this book to the non-American soil investigator that the methods of chemical analysis should be exclusively those favoured by American workers and that the grading of the fractions in the mechanical analyses should be on a totally different basis from that adopted by the International Society of Soil Science and widely used in British tropical soil work. The variable depth to which the samples of soil for analysis were taken also renders comparison between the different types somewhat difficult.

The book as a whole represents an immense amount of labour and forms an important contribution to tropical agronomy.

**FIXATION OF ATMOSPHERIC NITROGEN.** By Frank A. Ernst. Pp. ix + 154, 9 × 6. (London: Chapman & Hall, Ltd., 1928.) Price 12s. 6d.

The majority of publications dealing with the fixation of atmospheric nitrogen have been written for the scientific

and technical worker. The author, recognising the needs of the ordinary reader, has written this book to meet them and has succeeded very well.

Sir William Crooke's prophecy in 1928 that ultimately starvation would await the world if it continued to depend on the Chilean nitrate beds as a source of nitrogenous fertiliser resulted in the establishment at Niagara, New York, of the first arc-process plant for the fixation of atmospheric nitrogen. Other plant on similar lines was erected in Norway. The cyanamide process next came into prominence and was followed by the direct synthetic ammonia process, which, on account of its greatly superior commercial efficiency, is largely replacing the older processes.

The history, establishment and working results in different countries of these processes and their different modifications are fully dealt with in the first six chapters of the book, a large amount of theoretical and practical information being given. Economic considerations, ammonia conversion products, and statistics are the subjects of the last three chapters. A number of appendixes give interesting and valuable information on the locations, capacities and 1927 rate of production of the 84 fixed nitrogen plants of the world as well as domestic productions, exports and apparent consumptions of nitrogen products of the principal countries for the years 1910 to 1925. The book concludes with a useful selected bibliography and an index.

AGRICULTURAL GEOLOGY. By Frederick V. Emerson, Ph.D. Revised by John E. Smith. Pp. xvi + 377, 8½ × 5½. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1928.) Price 16s.

The book gives an account of those elementary aspects of geology which may be regarded as of chief importance to the student of agriculture. In a foreword to the first edition, which was published in 1920, H. Ries states that it is the outgrowth of some years of experience in teaching geology to students of agriculture, and that the author endeavoured to make the treatment of the subject as untechnical as possible, without sacrificing scientific accuracy. For such as require a very elementary textbook it should prove useful, covering as it does the general groundwork of geological science, with special reference to the formation of soils and other superficial deposits. There is a separate chapter on "Mineral fertilisers" and another on "Soil Regions of the United States." The book is well illustrated and indexed.

**THE CLEANING OF COAL.** By W. R. Chapman, B.Sc., Tech. M.Sc., Ph.D., Assoc.M.I.Min.E., and R. A. Mott, M.Sc., F.I.C., Assoc.M.I.Min.E. With an Introduction by Professor R. V. Wheeler, D.Sc., F.I.C., F.G.S. Pp. xi + 680, 10½ × 6½. (London: Chapman & Hall, Ltd., 1928.) Price 42s. net.

Up to within recent times the high quality of all classes of English coals was one of the main reasons for the supremacy of Great Britain in the coal export trade of the world. Only the highest grade seams were mined and a little hand-picking was all that was necessary by way of treatment. British coals differ from those on the Continent in that they have less tendency to break up in mining, and it has been easy to produce commercial grades of high quality. To offset these advantages of British coals, foreign producers have been giving more and more attention to cleaning their more friable coals, with the result that their products are now often able to compete with those of England not only in price but in quality. In one case, cited by Professor Henry Louis, a Scandinavian railway contract for coal went to Germany simply because of the cleaner coal offered.

At the present time in Great Britain the available amount of coal from the best seams has become considerably lessened and seams of lower grade are being mined.

In an introduction to this book, written by Professor R. V. Wheeler, it is pointed out how necessary it is for England, in attempting to regain lost coal markets, to give much increased attention to the preparation of coal, for which, according to the authors, there is only a washing capacity of 28 per cent. of the present output, whilst in Belgium, for example, the capacity is 85 per cent. At the same time, it is noteworthy that English inventiveness has played a great part in the science of coal cleaning.

The authors are specialists in the subject and each contributed a paper connected with coal cleaning at the recent World Fuel Conference. Their book promises to be a standard work for some time to come, as it gives a wealth of detail both theoretical and practical on every phase of the subject.

The first 6 chapters treat with impurities in coal, its preliminary examination, the theory of jig and upward-current washing methods and the development of cleaning processes. In the next 17 chapters are described the uses of jigs, upward current and trough machines, endless belts and concentrators, dry-cleaning processes, methods using media of high density and froth flotation. The next 8 chapters are devoted to pan-ash separators, the dewatering



of coal products, the treatment of washery water, feeding, conveying and screening apparatus and methods of control. Two final chapters deal with the economics of coal cleaning and its advantages to each of the coal-consuming industries. The book is well illustrated, and both authors and publishers are to be complimented on their work.

**THE UNITED STATES OIL POLICY.** By John Ise, Ph.D., LL.B. Pp. viii + 547, 10 × 6½. (New Haven : Yale University Press. London : Humphrey Milford, Oxford University Press, 1928.)

This is a reprint of a work first published in 1926. The first chapter gives a succinct history of petroleum in ancient and mediæval times. Then follow several chapters on the early history of petroleum in Pennsylvania and New York, and other States, including over-production and waste of oil, waste of capital and energy, some attempts at curtailment and monopolistic conditions in the oil industry. In this connection the history, vicissitudes and enormous power wielded by the Standard Oil Company are clearly stated. The author points out that in its policy of conserving oil and oil products, this company "has rendered a service to the people of the United States which will probably be better appreciated when the end of our oil reserves is in sight."

There are chapters on the development of conservation sentiment, the placer law, public oil lands, withdrawals, the leasing law, naval reserves—the Teapot dome scandal in connection with the last is well described—and Indian oil lands.

One chapter deals with the results of the United States Oil Policy, and the present position. The question of substitutes for oil products and foreign supplies of oil are also dealt with.

The work is well written and illustrated, and, although composed by an American for Americans, it should be carefully read by all interested in the petroleum deposits and petroleum industries of other parts of the world.

**THE GEOLOGY OF PETROLEUM AND NATURAL GAS.** By Ernest Raymond Lilley, Sc.D. Pp. x + 524, 9 × 6. (London : Chapman & Hall, Ltd., 1928.) Price 30s.

The author, Dr. Lilley, has already written a notable book on the Oil Industry (1926). The present work is undoubtedly one of the best hitherto published on the geology of petroleum, and, although the oilfields described are in the main those of the United States, notable fields in other parts of the world have not been neglected.

The early chapters deal with the properties and origin of petroleum and bitumens. The fundamental geologic conditions limiting the occurrence of petroleum are next considered, this being followed by an account of the geologic history and occurrence of oil. Then it is shown that the division of rocks into container and retainer types depends solely upon their porosities. The concentration of oil and gas in porous rocks is next considered.

Probably the most interesting chapters of the book are those on structure in relation to petroleum deposits. The author describes the characteristics of folded structure, those dominated by faulting, accumulations controlled by porosity, salt core structures—including the peculiar "diapir" folds of the Carpathians—and accumulations in complex structures.

The work ends with a short chapter on the exploration of new areas. It is well illustrated, and should prove most useful not only to students of petroleum geology, but as a book of reference to oil geologists at home and in the field.

A selected bibliography is given at the end of nearly every chapter.

**PETROLEUM-VADEMECUM.** By Ing. Robert Schwarz. Fifth edition. Pp. 457,  $6 \times 4\frac{1}{2}$ . (Berlin and Vienna: Verlag für Fachliteratur, 1928.) Price 15 Marks.

The first portion (about one-third) of the new edition of the vademecum is taken up with various conversion tables used in the petroleum industry and commerce. Then follow about 100 pages of customs' duties on mineral oils and their products, succeeded by 136 pages of prices and production of petroleum and petroleum products in various countries, this portion of the work being illustrated by numerous graphs. There is a supplement containing corrections and additions to the various tables, etc., and concluding with sketch-plans of the world's principal petroleum ports.

As a reference book the little work should prove most useful to both producers and users of petroleum.

✓ **CLAYS: THEIR OCCURRENCE, PROPERTIES AND USES.** By Heinrich Ries, Ph.D. Third edition, revised and enlarged. Pp. vii + 613,  $9 \times 5\frac{1}{2}$ . (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1927.) Price 35s.

A new edition of this important textbook after a period of nearly twenty years is very welcome. The general treatment of the subject remains the same as in the last

edition except that the chapter on methods of mining and manufacture has been omitted and new sections on bentonite and the areal distribution of clays in Canada have been added.

Whilst retaining its old form, the whole work has been very carefully revised and brought up to date. Having regard to the vast literature which has accumulated during the past two decades this has been no small task, and the author is to be congratulated upon its successful accomplishment.

**CEMENTS, LIMES AND PLASTERS. THEIR MATERIALS, MANUFACTURE AND PROPERTIES.** By Edwin C. Eckel, C.E. Third edition. Pp. xxxiv + 699,  $6\frac{1}{2} \times 9\frac{1}{2}$ . (New York: John Wiley & Sons, Inc., London: Chapman & Hall, Limited, 1928.) Price 35s. net.

The third edition of this work fully maintains the high standard of the two preceding editions, which were reviewed in this BULLETIN (1906, 4, 369, and 1923, 21, 422).

The industry generally has shown little progress in regard to the cements dealt with in the second edition, and hence in regard to these no special revision has been necessary. On the other hand, however, important advances have been made in the manufacture and use of certain other types of cement, necessitating a detailed description of the preparation and properties of these materials. Accordingly, the work has been increased by the addition of chapters dealing both with aluminous cements and those of the "rapid hardening" or "accelerated" Portland type.

The composition and origin of various highly aluminous minerals available for the production of aluminous cements are discussed, and emphasis is laid upon the suitability of the hydrous oxides of aluminium, of which bauxite is a typical example, to the exclusion of most other minerals. Analyses are quoted of bauxite from deposits in the United States and in various parts of Europe and Asia.

Attention is drawn to the fact that the iron content of the various aluminium minerals has a direct bearing upon the particular method of manufacture to be adopted, and analyses of the manufacturing costs are shown for various methods of burning the raw materials. A description of the composition and physical characteristics of the aluminous cements completes this portion of the work.

The concluding chapter of the book deals with the raw material and the manufacturing conditions necessary for the production of a high-grade cement of the "accelerated" Portland type, and in this connection the

author indicates the applicability of his "Cementation Index" to the proportioning of the raw mix. The improvement in the product which can be effected by greater attention to the details of manufacture, is shown in a series of tables giving the results of comparative tests of "ordinary" and "accelerated" Portland cements produced from the same raw materials at Swiss, French and American works respectively.

The author puts forward some interesting suggestions for overcoming the difficulties encountered in attempting to secure still greater strength with these types of cement, and to enable them to compete successfully with the aluminous varieties as regards resistance to the disintegrating effect of sulphate and sea-waters.

The statistical matter in the book has been thoroughly revised and brought up to date. As in the two previous editions, comprehensive references to original sources of information add considerably to the value of the work.

CERAMIC TESTS AND CALCULATIONS. By A. I. Andrews, Ph.D. Pp. viii + 172,  $7\frac{1}{2} \times 5$ . (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1928.) Price 11s.

The science of ceramics is gradually becoming more exact, and calculation and testing are displacing the rule-of-thumb methods which have often, in many branches of this industry, been considered adequate. Any work which helps forward the application of scientific procedure is to be welcomed, and the volume under notice should prove helpful to those directly interested in the theory and practice of clay-working.

The first portion of the book, comprising five chapters, deals mainly with the testing of raw and fired clay products and with the calculations relating thereto. Theoretical considerations are briefly discussed, and the practical methods given are those recommended by the American Ceramic Society Committee on Standards.

The remaining chapters deal with the principal calculations concerning bodies, glazes, and glasses. This is probably the most useful portion of the book, as the problems incidental to the compounding of bodies and glazes, the blending of glazes, the use of triaxial diagrams, etc., are presented in a compact and convenient form.

The exercises set at the close of each chapter should prove useful to students and those unfamiliar with the principles involved.

The book can be recommended as a useful summary of the main tests and calculations necessary for clay-workers.

**THE PROPERTIES OF SILICA.** By Robert B. Sosman, Ph.D. Pp. 855, 9 × 6. (New York: The Chemical Catalog Company, Inc., 1927.) Price \$12.50.

Considering that silica, even in the free condition, is such an abundant constituent of the earth's crust, and that it occurs in such a variety of interesting and different forms, both crystalline and amorphous, it is no wonder that a large number of investigators have made studies of its properties. The arduous work of sorting, abstracting and compiling the results of these investigations into one volume is in itself no mean task, but the author of the present work has done much more, for he has endeavoured to interpret them in the light of modern conceptions as to the constitution of matter, and has successfully woven the whole into a connected and readable story.

The work (which is No. 37 in the American Chemical Society Monograph Series) is divided into eight parts. The first deals with fundamentals, and discusses the properties of matter, the composition of silica and its atomic constitution. The second considers phases and their transformations; it describes the eight modifications of silica the properties of which are fairly well defined (seven being crystalline), with the two less well defined chalcedonic and finely divided amorphous forms, and discusses their inversions. The third part deals with symmetry and structure, and consists principally of geometrical and crystallographic considerations. Part four is devoted to the storage and flow of thermal energy and the changes in volume and shape which accompany thermal changes. Part five deals with mechanical energy aspects such as compressibility, elasticity, strength and hardness, including surface energy aspects such as crystal habit. The sixth part is devoted to the behaviour of silica in electric and magnetic fields and includes piezo-electric and pyro-electric properties. The seventh part, which is entitled "Silica in the periodic electro-magnetic field," is devoted almost entirely to optical properties, and is the longest part of the book. The eighth and final part deals with applications, geological, industrial, chemical and physical; it was evidently included only for the sake of completeness and does not attempt more than a brief outline of this aspect of the subject, which in itself might be made to fill volumes.

The economic value of such a work as this, consisting as it does so largely of purely physical data obtained in the laboratory, may not be immediately apparent. Nevertheless its value from this point of view is great, for the

problems of the industrial applications of non-metallic minerals such as silica can most readily be overcome when works of this nature are available for reference, providing as they do a source of abundant and accurate fundamental data which can be drawn upon and applied to the particular problem to be solved.

The work is thoroughly commendable and will no doubt long remain a standard book of reference.

**THE DETERMINATION OF MINERALS UNDER THE MICROSCOPE.** By John W. Evans, C.B.E., D.Sc., LL.B., F.R.S., F.G.S. Pp. xii + 110,  $7\frac{1}{4} \times 4\frac{3}{4}$ . (London: Thomas Murby & Co.; New York: D. Van Nostrand Co., 1928.) Price 7s. 6d.

This elementary textbook is designed with a view to assisting students to realise the principles on which the optical study of minerals rests, without recourse to advanced mathematics. It deals more particularly with the interpretation of interference phenomena and is an extension of the author's well-known papers on the same subject published in the *Proceedings of the Geologists' Association*, 1909, and in the *Journal of the Quekett Club*, 1915. Special attention has been devoted to the explanation of the optical indicatrix, and the little book gives a clear and careful account of a subject which constitutes a stumbling block to many students of petrology. The author employs several unusual terms such as "hodoscope" and "directions image," but these are not likely to confuse the student, as their significance is clearly explained. The book is well illustrated, and should prove a very useful guide to the study of a rather difficult subject.

**ELEMENTS OF OPTICAL MINERALOGY.** An Introduction to Microscopic Petrography. By Alexander N. Winchell, Part I. Principles and Methods. Pp. viii + 238,  $9 \times 6$ . Third edition, revised and enlarged. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1928.) Price 17s. 6d.

The second edition of the first part of this work, published in 1922, has been noticed in this *BULLETIN*, 1923, 21, 420. Excepting a few minor alterations, the new edition is exactly the same as the last, apart from a new chapter of 22 pages that has been added at the end. This chapter, entitled "Special methods of study," is devoted to descriptions of the use of Federov's universal stage, and the recently-introduced methods of measuring the

refractive index of mineral grains known as the single and double dispersion methods. These methods, which are due to Merwin, Tsuboi and Emmons, make use of the fact that the refractive indices of liquids used for immersion vary with temperature and with the wave-length of the light employed. Naturally, the special methods of study described can only be employed by those workers who are fortunate enough to possess the special apparatus necessary, or to whose existing microscopes they can be fitted.

The new chapter brings Part I up to date, and the fact that a new edition has been called for so soon shows that the work has received the appreciation it deserves. The second edition has not yet been completed and the appearance of the promised third part is awaited with interest.

**THE SAFETY IN MINES RESEARCH LABORATORIES, SHEFFIELD: A DESCRIPTION.** Safety in Mines Research Board, Paper No. 44, Mines Department. Pp. 19, 9½ × 6, (London: H.M. Stationery Office, 1928.) Price 6d.

The second research station erected for the work of the Safety in Mines Research Board out of grants voted by the Miners' Welfare Committee from their Fund has just been completed at Sheffield. The first station, situated near Buxton, designed for carrying out such experiments as large-scale explosions, was opened in June 1927. The Sheffield station consists of laboratories for small-scale experimental work, and the staffs of the two stations work as one unit. The establishment of these two stations is the last step in the efforts made for more than a century to apply the systematic methods of science to the solution of problems of the dangers of coal mining.

A complete description of the Sheffield Laboratories is given in this paper. It supplies (Part I), a summary of the researches which are being carried out by the S.M.R.B., indicating how the various problems of the dangers of coal mining are systematically handled and their solution sought. It also contains (Part II) a description of the new building and its equipment, and (Part III) describes the research work at present in progress in the laboratories. The paper is illustrated by a plan showing the arrangement of the rooms on the different floors, and by photographs taken in the principal laboratories.

A description of the Buxton Research Station was published last year in S.M.R.B. Paper No. 34. (H.M. Stationery Office, 6d. net.).

**ANNUAIRE INTERNATIONAL DES MINES ET DE LA MÉTALLURGIE.** Edition 1928. By Robert Petavel. Pp. vii + 768, 8½ × 5. (Paris: Société des Publications Minières et Métallurgiques.)

The statistics given in this useful annual are, as might have been expected, not of uniform value, for the statistics of some countries are very late in publication, and those of others difficult, if not impossible, to ascertain with any degree of accuracy. In some instances, however, later figures than those given are available.

The world's outputs of copper, tin, aluminium, petroleum and bauxite are given for 1927; those of coal and lignite, the smelter production of zinc, lead, copper, tin, gold and silver for 1926; diamonds and manganese for 1925; the world's output of mercury, the tin-ore production of Nigeria, the mineral production of British India and the antimony production of China for 1924; while the tin and tin-ore production of the Netherlands East Indies and the mineral production of Japan is given down to 1922 only.

The mineral statistics of France and her dependencies, and a list of mines and quarries, mining companies, metallurgical works and mineral industries, etc., cover about 200 pages of text.

The rest of the work includes the mineral production, principal mines, metallurgical works, and mineral industries of Europe, Asia, Africa and America.

The list of owners of the mining, metallurgical and industrial undertakings of the various countries will be found very useful for reference purposes.

**THE ASLIB DIRECTORY.** A Guide to Sources of Specialised Information in Great Britain and Ireland. Edited by G. F. Barwick, B.A. Pp. xiii + 425, 11 × 7½. (London: Published jointly by the Association of Special Libraries and Information Bureaux and The Oxford University Press, 1928.) Price 21s.

The Association of Special Libraries and Information Bureaux have performed a very useful service in arranging the issue of this Directory, which will enable students to get into touch with libraries and other institutions which specialise in particular subjects.

The Directory is divided into three parts. The first contains entries under subjects, arranged alphabetically, each item having reference to places where information relating to that subject is available, including not only libraries but enquiry bureaux and similar organisations. In the case of the larger subjects, the titles and publishers



of periodicals pertaining thereto are given. The second part gives the times of opening, scope and other particulars in respect of the various libraries, etc., mentioned in Part I, arranged alphabetically under the names of the towns in which the institutions are located. The third part is an index to special collections of books and manuscripts.

It is almost impossible for the first issue of a book of this character to be complete, but as far as it goes it will prove of great value to all in search of special information. Particulars regarding certain information bureaux which do not possess libraries or collections of materials and which are not included in the Directory, are available for consultation by members at the offices of the Association.

### BOOKS RECEIVED FOR NOTICE

THE TROPICAL CROPS. By Otis Warren Barrett, B.Sc. Pp. xviii + 445,  $7\frac{1}{4} \times 4\frac{3}{4}$ . (New York: The Macmillan Company; London: Macmillan & Co., Ltd., 1928.) Price 17s.

PRINCIPLES OF PLANT PATHOLOGY. By Charles Elmer Owens. Pp. xii + 629,  $9 \times 5\frac{3}{4}$ . (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1928.) Price 23s. 6d.

CATTLE MANAGEMENT: A TEXTBOOK FOR THE USE OF NATIVE SCHOOLS IN AFRICA. By J. R. Fell and R. A. S. Macdonald, B.Sc., M.R.C.V.S. Pp. 83,  $7\frac{1}{4} \times 4\frac{3}{4}$ . (London: Christian Literature Society for India and Africa, 1928.) Price 1s.

POULTRY HUSBANDRY: A TEXTBOOK FOR NATIVE SCHOOLS IN AFRICA. By J. R. Fell. Pp. vi + 66,  $7\frac{1}{4} \times 4\frac{3}{4}$ . (London: Christian Literature Society for India and Africa, 1928.) Price 1s.

COLLOID SYMPOSIUM MONOGRAPH. Papers presented at the Sixth Symposium on Colloid Chemistry, University of Toronto, June 1928. Edited by Prof. Harry Boyer Weiser. Pp. 346,  $9 \times 6$ . (New York: The Chemical Catalog Company, Inc., 1928.) Price \$6.50.

QU'EST-CE QUE LA PRÉVENTION DU FEU? By F. Michotte. Pp. 28,  $9\frac{1}{2} \times 6$ . (Paris: Société Propagande Coloniale, 1927.) Price 2 francs.

ÉTUDE SUR L'ORIGINE DE L'AMIANTE. By F. Michotte. Pp. 23,  $9\frac{1}{2} \times 6$ . (Paris: Société Propagande Coloniale, 1928.) Price 2 francs.

## VOL. XXVI, 1928

## INDEX

*Botanical names and titles of books are printed in italics and authors' names in capitals*

	PAGE
<i>Acacia arabica</i> pods .. .. .	35, 36, 37
Achin or Takwadua ( <i>Blighia sapida</i> ), timber from Gold Coast	275
<i>Aerial Survey in Relation to the Economic Development of New Countries, with Special Reference to an Investigation carried out in Northern Rhodesia</i> .. .. .	529
<i>Agricultural Development of Arid and Semi-Arid Regions, with Special Reference to South Africa</i> .. .. .	398
<i>Agricultural Geology</i> .. .. .	536
Alcohol, from the nipa palm in Malaya .. .. .	161
„, production from various sources in the Federated Malay States .. .. .	222
<i>Aleurites triloba</i> (= <i>A. moluccana</i> ), experimental cultivation in Federated Malay States .. .. .	487
Algarobilla, use as a tanning material .. .. .	33
ALLISON, R. V. (see BENNETT, H. H.)	
<i>Aluminium Bronze Powder and Aluminium Paint</i> .. .. .	127
AMAN, W. C., <i>Cotton in South and East Africa</i> .. .. .	260
Ananta or Takroa ( <i>Cynometra</i> sp.), timber from Gold Coast .. .. .	276
<i>Anaphrenium argenteum</i> (kliphout), use as a tanning material	312
Andiroba oil .. .. .	411
• ANDREWS, A. I., <i>Ceramic Tests and Calculations</i> .. .. .	541
Annatto, experiments in Federated Malay States .. .. .	476
„ in Ceylon .. .. .	80
<i>Annuaire International des Mines et de la Métallurgie</i> .. .. .	545
<i>Anogeissus latifolia</i> (dhawa), use as a tanning material .. .. .	312
Antigua, fruit production in .. .. .	181
Aoula .. .. .	317
Arara nuts ( <i>Joannesia heveoides</i> ) from Brazil .. .. .	416
<i>Artificial Silk</i> .. .. .	525
<i>Artificial Silk. The Manufacture of, with Special Reference to the Viscose Process</i> .. .. .	261
Asbestos mining in Southern Rhodesia .. .. .	234
„ production in Cyprus .. .. .	225, 478
<i>Aslib Directory</i> .. .. .	545

	PAGE
<i>Aspidosperma excelsum</i> wood for paper-making .. ..	5
<i>Astrocaryum Jauari</i> fruits from British Guiana .. ..	413
<i>Astronomy, A Manual of Field</i> .. ..	272
<i>Aucoumea Klaineana</i> wood.. ..	379
Australia, cotton cultivation in .. ..	93
" <i>Pinus insignis</i> timber grown in .. ..	494
"    "    "    wood for paper-making in .. ..	491
"    "    "    tanning materials of. . . . . 31, 38, 312, 315, 318	
"    "    "    timbers for the production of paper pulp .. ..	95
"    "    "    timber seasoning in .. ..	496
"    "    "    Western, peppermint oil production in .. ..	364
"    "    "    "    sandalwood oil, characters of .. ..	366
"    "    "    "    regeneration in .. ..	365
Avara palm .. ..	414
Awarra palm fruits ( <i>Astrocaryum Jauari</i> ) from British Guiana	413
Awieforsemea timber from Gold Coast .. ..	275
Babul ( <i>Acacia arabica</i> ) pods from India .. ..	36
Badamier ( <i>Terminalia Catappa</i> ) bark .. ..	375
BALLS, W. L., <i>Studies of Quality in Cotton</i> .. ..	520
Bamboo ( <i>Oxytenanthera abyssinica</i> ) in Southern Rhodesia .. ..	377
BAMFORD, T. G., and HARRIS, H., <i>Metallurgist's Manual</i> .. ..	130
Bananas, recent research on .. .. 182, 340, 450	
Barley, variety experiments in Iraq .. ..	176
Barytes deposits in Southern Rhodesia .. ..	236
<i>Bauxite, Industrial Uses of</i> .. ..	406
Bauxite, occurrence in Gold Coast .. ..	481
"    of the Zomba Plateau, Nyasaland .. ..	228
Beans, variety trials in Uganda .. ..	188
BEAR, F. E., <i>Soil Management</i> .. ..	123
Beetles injurious to timber .. ..	164
BENNETT, R. H. H., and ALLISON, R. V., <i>The Soils of Cuba</i> .. ..	534
<i>Blighia sapida</i> timber from Gold Coast .. ..	275
BOLTON, E. R., <i>Oils, Fats and Fatty Foods: Their Practical Examination</i> .. ..	259
BOND, J. R., and others, <i>British Farmers in Denmark</i> .. ..	257
BOURNE, R., <i>Aerial Survey in Relation to the Economic Development of New Countries, with Special Reference to an Investigation carried out in Northern Rhodesia</i> .. ..	529
Brazil, arara nuts ( <i>Joannesia heveoides</i> ) from .. ..	416
BRIGGS, D. H. CURRER, notes on coal mining in Canada .. ..	60
<i>Britain's Fuel Problems</i> .. ..	406
British East Africa, tanning materials of .. ..	31
<i>British Empire Vegetation Abstracts</i> .. ..	165
<i>British Farmers in Denmark</i> .. ..	257
British Guiana, awarra palm fruits ( <i>Astrocaryum Jauari</i> ) from	413
"    "    "    crabwood seeds and oil ( <i>Carapa guianensis</i> ) from	411
"    "    "    forestry in .. ..	220
"    "    "    mineral resources of .. ..	476

	PAGE
British Guiana, timbers in .. .. .	221
"    "    , woods for paper-making from .. .. .	4
Honduras, chicle gum investigations in .. .. .	222
"    "    , citrus fruit industry in .. .. .	75, 183
"    "    , <i>Paspalum conjugatum</i> grass from .. .. .	296
"    "    , sponge investigations in .. .. .	223
"    "    , timbers in .. .. .	222
Malaya, coconut industry of .. .. .	488
"    "    , nipa palm in .. .. .	161
"    "    , oil-palm industry of .. .. .	88, 360, 361
"    "    , (see also Federated Malay States)	
West Africa, oil-palm in .. .. .	358
"    "    "    , tanning materials of .. .. .	37
"    "    Indies, tanning materials of .. .. .	31
<i>Bruguiera gymnorhiza</i> wood from Madagascar, paper-making trials with .. .. .	493
Buckwheat, seeding experiments in Uganda .. .. .	176
BURT, F. A., <i>Soil Mineralogy</i> .. .. .	132
BURTON, W. K., <i>The Water Supply of Towns and the Construction of Waterworks</i> .. .. .	271
<i>Casalpinia brevifolia</i> .. .. .	33
" <i>coriaria</i> .. .. .	31
" <i>digyna</i> .. .. .	34
<i>Callitris</i> spp. (pine barks), use as a tanning material .. .. .	313
Camphor leaves and twigs from St. Lucia .. .. .	294
Canada, copper mining region of Rouyn .. .. .	58
"    , gold mining in Ontario .. .. .	53
"    , mining metallurgical and power developments in the provinces of Ontario and Quebec .. .. .	42
"    , nickel mines in Ontario .. .. .	45
"    , notes on coal mining in .. .. .	60
"    , present status and future possibilities of the mining industry in British Columbia .. .. .	69
"    , silver mining in Ontario .. .. .	49
"    , steel manufacture in .. .. .	43
"    , water power resources of the Niagara and the Saguenay .. .. .	44
Canaille ( <i>Rumex hymenosepalus</i> ), use as tanning material .. .. .	37
Candlenuts ( <i>Aleurites triloba</i> ), experimental cultivation in Federated Malay States .. .. .	487
Cane Sugar, <i>Economic Aspects of Production</i> .. .. .	121
Caoutchouc (Le): <i>Etude Economique et Statistique</i> .. .. .	525
<i>Carapa guianensis</i> seeds and oil from British Guiana .. .. .	411
<i>Carissa spinarum</i> (karunda), use as a tanning material .. .. .	314
CARLOS, A. S., <i>Feeding Stuffs</i> .. .. .	517
CARSLAW, R. MCG., and KIRKPATRICK, W. H., <i>An Economic and Financial Analysis of Fifteen East Anglian Farms, 1926-27</i> .. .. .	516
CARSLAW, R. MCG., and others, <i>Sugar Beet in the Eastern Counties, 1927</i> .. .. .	517

	PAGE
CARTER, D. G. (see FOSTER, W. A.)	
Cassava, recent research on .. .. .	188
Cassiterite, magnetic, in Federated Malay States .. .. .	480
Casuarina equisetifolia bark .. .. .	376
Cellulose Lacquers .. .. .	526
Cements, Limes and Plasters .. .. .	540
Ceramic Tests and Calculations .. .. .	541
Ceriops Boiviniana wood from Madagascar, paper-making trials with .. .. .	493
Ceylon, annatto in .. .. .	80
" , bunchy top disease of bananas in .. .. .	450
" , chaulmoogra oils in .. .. .	79
" , citronella experiments in .. .. .	80, 459
" , cocoa pests in .. .. .	437
" , coconut, investigations in .. .. .	346
" , " , pests and diseases in .. .. .	456
" , cotton, experiments in .. .. .	350
" , " , industry and experiments in .. .. .	460
" , " , production in .. .. .	81
" , derris investigations in .. .. .	78
" , experiments in use of coconut husks in .. .. .	80
" , fodder plant investigations in .. .. .	448
" , ground-nut experiments in .. .. .	457
" , manuring experiments in .. .. .	334
" , oil palm in .. .. .	458
" , rice investigations in .. .. .	339, 442
" , rubber experiments in .. .. .	351, 471
" , sisal experiments in .. .. .	350, 471
" , " in .. .. .	369
" , soil and manurial investigations in .. .. .	432
" , sugar-cane experiments in .. .. .	341, 454
" , tea investigations in .. .. .	337, 438
" , " pests in .. .. .	439
" , tobacco cultivation in .. .. .	80
" , " experiments and pests in .. .. .	472
" , waste vegetable products for fuel in .. .. .	80
Chaillietia toxicaria, from Sierra Leone .. .. .	143.
CHAPLIN, C. J., Tests of Small Clear Specimens .. .. .	532
" , " , Tests of Some Home-grown Timbers in their Green Condition .. .. .	531
CHAPMAN, W. R., and others, The Cleaning of Coal .. .. .	537
Chaulmoogra oils, experiments in Ceylon .. .. .	79
Chemistry of Crude Drugs .. .. .	533
Chicle gum, investigations in British Honduras .. .. .	222
CHILDE, H. L., Manufacture and Uses of Concrete Products and Cast Stone .. .. .	270
CHIFF, T. F., The Gold Coast Forest: A Study in Synecology .. .. .	122
Chrome ore, production in Cyprus .. .. .	224, 479
Chronicles of Kenya .. .. .	516
Chrysanthemum cineraraefolium (see Pyrethrum)	

	PAGE
Cinchona bark from Uganda .. .. .	17
Citronella oil, recent research on .. .. .	459
Citrus fruits, cultivation in Rhodesia .. .. .	86
"    "    , industry in British Honduras .. .. .	75, 183
"    "    , recent research on .. .. .	183, 451
<i>Citrus Products, Part II</i> .. .. .	259
Clay, brick-making trials in Federated Malay States .. .. .	481
<i>Clays: Their Occurrence, Properties and Uses</i> .. .. .	539
Clays, trials with, from Nigeria at the Imperial Institute .. .. .	227
<i>Cleaning of Coal</i> .. .. .	537
Clove industry in Madagascar .. .. .	323
Coal, black, deposits in Nigeria .. .. .	227
"    , brown, of the British Empire .. .. .	151
Coal deposits in Nigeria .. .. .	227, 482
<i>Coal in Great Britain</i> .. .. .	127
Coal in Nyasaland .. .. .	229
"    "    Tanganyika .. .. .	239
"    mining in Canada .. .. .	60
<i>Coal, The Cleaning of</i> .. .. .	537
<i>Coal-washing Practice, Modern</i> .. .. .	270
Cocoa, recent research on .. .. .	173, 437
Coconut husks, experiments in use of in Ceylon .. .. .	80
"    industry of British Malaya .. .. .	488
Coconuts, recent research on .. .. .	196, 346, 455
"    , wilt disease in Trinidad .. .. .	357
Coffee from Mauritius, Sierra Leone and Sudan .. .. .	418
"    production in Kenya .. .. .	355
"    , recent research on .. .. .	175, 336, 438
Cola in the Gold Coast .. .. .	220
COLLET, L. W., <i>The Structure of the Alps</i> .. .. .	128
<i>Colloid Chemistry</i> .. .. .	533
<i>Colpoon compressum</i> (Cape sumach), use as a tanning material .. .. .	314
<i>Condensed Milk. A Study of Condensed, Evaporated and Powdered Milk</i> .. .. .	401
Copper mining in Quebec .. .. .	58
"    occurrences in Tanganyika .. .. .	239
"    precipitate, production in Cyprus .. .. .	224
<i>Copra and Coconut Oil</i> .. .. .	519
<i>Cornish Miner, The</i> .. .. .	266
CORRIE, F. E., <i>Manure and Manuring</i> .. .. .	125
Cotton cultivation in Queensland .. .. .	93
<i>Cotton in South and East Africa</i> .. .. .	260
Cotton production in Ceylon .. .. .	81
"    , ratoon cultivation in Egypt .. .. .	367
"    , recent research on .. .. .	204, 350, 460
<i>Cotton, Studies of Quality in</i> .. .. .	520
<i>Courbonia</i> sp. ("Kiligi"), poisonous properties of tuber .. .. .	322
Cover crops, recent research on .. .. .	168, 432
COX, J. F., and STARR, G. E., <i>Seed Production and Marketing</i> .. .. .	125
Crabwood seeds and oil ( <i>Carapa guianensis</i> ) from British Guiana .. .. .	411

	PAGE
Crops, rotation trials in Sierra Leone .. ..	168
CUNNINGHAM, J. C., <i>Products of the Empire</i> .. ..	399
Cypress pine .. ..	313
Cyprus, fuel value of briquettes from waste flax .. ..	213
"  , mineral resources of .. ..	223, 478
"  , sand-drift planting in .. ..	327
"  , silk investigations in .. ..	214
"  , weight of tree seeds .. ..	221
<i>Dairy Cattle Feeding and Management</i> .. ..	534
DAVIS, A., and ROBERTSON, H. G., <i>Chronicles of Kenya</i> .. ..	516
<i>Derris</i> spp. ( <i>see</i> Tuba)	
<i>Determination of Minerals under the Microscope</i> .. ..	543
Dhawa .. ..	312
Diamond production in Tanganyika .. ..	238
<i>Dimorphandra Mora</i> wood for paper-making .. ..	5
Divi-divi pods .. ..	31
DOLMAGE, V., present status and future possibilities of the mining industry in British Columbia .. ..	69
Dominica, limes industry in .. ..	184
DOWLING, R. N., <i>Sugar Beet and Beet Sugar</i> .. ..	258
DRIVER, J. E., and TREASE, G. E., <i>The Chemistry of Crude Drugs</i> .. ..	533
<i>Dry-rot in Wood</i> .. ..	530
ECKEL, E. C., <i>Cements, Limes and Plasters</i> .. ..	540
<i>Economic and Financial Analysis of Fifteen East Anglian Farms, 1926-27</i> .. ..	516
EDWARDS, J. D., <i>Aluminium Bronze Powder and Aluminium Paint</i> .. ..	127
Egypt, ratoon cotton in .. ..	367
Elands Boontjes .. ..	314
<i>Electro-Farming, or the Application of Electricity to Agriculture</i> .. ..	402
<i>Elements of Optical Mineralogy</i> .. ..	131, 543
<i>Elephantorrhiza Burchellii</i> (Elands Boontjes), use as a tanning material .. ..	314
<i>Eleusine coracana</i> , variety trials in Uganda .. ..	177
EMERSON, F. V., <i>Agricultural Geology</i> .. ..	536
<i>Empire Grown Sisal</i> .. ..	426
<i>Entandrophragma</i> sp. timber from Gold Coast .. ..	275
<i>Eperua falcata</i> wood for paper-making .. ..	5
ERNST, F. A., <i>Fixation of Atmospheric Nitrogen</i> .. ..	535
<i>Eschweilera laevifolia</i> wood for paper-making .. ..	5
Essential oils, Australian sandalwood .. ..	365
"  "  , citronella .. ..	459
"  "  , clove .. ..	323
"  "  , patchouli .. ..	204
"  "  , peppermint .. ..	364
<i>Eucalyptus alba</i> (ridge or poplar gum), use as a tanning material .. ..	315
" <i>calophylla</i> (red-gum, marri), use as a tanning material .. ..	316

	PAGE
<i>Eucalyptus diversicolor</i> (karri), use as a tanning material ..	317
" <i>gomphocephala</i> (tuart), use as a tanning material ..	317
<i>Eucarya spicata</i> oil .. .. .	366
<i>Eugenia</i> spp. bark .. .. .	375
EVANS, J. W., <i>The Determination of Minerals under the Microscope</i> .. .. .	543
<i>Extra Pharmacopæia of Martindale and Westcott</i> .. ..	400
<i>Farm Buildings</i> .. .. .	517
<i>Farm Machinery</i> .. .. .	517
<i>Farm Soils. Their Management and Fertilization</i> .. ..	123
<i>Fats and Oils Studies of the Food Research Institute, Stanford University, California. No. 1, The Fats and Oils: A General View. No. 2, Copra and Coconut Oil</i> .. .. .	519
Federated Malay States, annatto experiments in .. ..	476
"    "    "    , banana investigations in .. ..	182
"    "    "    , candlenuts ( <i>Aleurites triloba</i> ), experimental cultivation in .. ..	487
"    "    "    , cassava, investigations in .. ..	188
"    "    "    , cocoa experiments in .. ..	173
"    "    "    , coconut experiments in .. ..	196, 457
"    "    "    , "    industry of .. ..	488
"    "    "    , coffee trials .. ..	175
"    "    "    , cover crop investigations in .. ..	432
"    "    "    , fodder grass trials in .. ..	181
"    "    "    , gambier experiments in .. ..	476
"    "    "    , jelutong experiments in .. ..	216, 472
"    "    "    , Mauritius hemp investigations in .. ..	213
"    "    "    , mineral resources of .. ..	480
"    "    "    , oil palm experiments in .. ..	200, 458
"    "    "    , "    "    in .. ..	488
"    "    "    , production of alcohol from various sources in .. ..	222
"    "    "    , rice experiments in .. ..	180
"    "    "    , rubber investigations in .. ..	215
"    "    "    , sisal experiments in .. ..	214, 471
"    "    "    , soil investigations in .. ..	169, 435
"    "    "    , tea trials in .. ..	176
"    "    "    , varieties of tuba root in .. ..	222, 476
<i>Feeding Stuffs</i> .. .. .	517
Fibres, flax .. .. .	213
<i>Fibres, Long Vegetable</i> .. .. .	521
Fibres, Manila hemp .. .. .	I
"    , Mauritius hemp .. .. .	213
"    , mohair .. .. .	140
"    , piassava .. .. .	213
"    , sisal .. .. .	214, 350, 369, 471
"    , wool .. .. .	76, 140, 215
Fiji, campaign against banana beetle in .. ..	182



	PAGE
Fiji, coconut investigations in .. .. .	197
„ , cotton investigations in .. .. .	204
„ , mineral resources of .. .. .	226
Filao ( <i>Cacuarina equisetifolia</i> ) bark .. .. .	376
Fish resources of Seychelles Islands .. .. .	87
Fixation of Atmospheric Nitrogen .. .. .	535
Flachs als Faser- und Ölpflanze .. .. .	120
Flax, recent research on .. .. .	213
Fodders, recent research on .. .. .	181, 448
Forestry in British Guiana.. .. .	220
„ „ Iraq .. .. .	221
FOSTER, W. A., and CARTER, D. G., <i>Farm Buildings</i> .. .. .	517
FOXWORTHY, F. W., <i>Commercial Timber Trees of the Malay Peninsula</i> .. .. .	262
FREEMAN, W. G., and WILLIAMS, R. O., <i>The Useful and Ornamental Plants of Trinidad and Tobago</i> .. .. .	258
French Colonial Timbers .. .. .	431
Fruit cultivation in Sierra Leone .. .. .	74
„ production in Antigua .. .. .	181
Fuller's earth from New Zealand .. .. .	148
Fundamentals of Biology .. .. .	403
<i>Fusanus spicatus</i> oil .. .. .	365, 366
Gambia ( <i>Acacia arabica</i> ) pods from West Africa .. .. .	37
„ , ground-nut investigations in .. .. .	81, 347
„ , sesame trials in .. .. .	82
Gambier, recent research on .. .. .	476
GARDNER, V. R., and others, <i>Orcharding</i> .. .. .	121
<i>Geologisches Praktikum</i> .. .. .	129
<i>Geology, Agricultural</i> .. .. .	536
<i>Geology of Malayan Ore-Deposits</i> .. .. .	404
<i>Geology of Petroleum and Natural Gas</i> .. .. .	538
<i>Geology, The Elements of Economic</i> .. .. .	265
Geranium oil, production in French colonies .. .. .	92
GIBSON, W., <i>Coal in Great Britain</i> .. .. .	127
Ginger, recent research on.. .. .	455
<i>Goat-Grazing and Forestry in Cyprus</i> .. .. .	402
Gold Coast, cocoa experiments in .. .. .	173, 437
„ „ , coconut experiments in .. .. .	198, 457
„ „ , cola, characters of seeds .. .. .	220
„ „ , cotton investigations in .. .. .	205
<i>Gold Coast Forest: A Study in Synecology</i> .. .. .	122
Gold Coast, limes cultivation in .. .. .	183
„ „ , maize yields in .. .. .	178
„ „ , mineral resources of .. .. .	481
„ „ , oil palm experiments in .. .. .	201, 458
„ „ , „ industry of .. .. .	359
„ „ , rubber tapping experiments in .. .. .	215
„ „ , sisal hemp cultivation in .. .. .	370

	PAGE
Gold Coast, sisal hemp investigations in .. ..	215
"  "  , tanning materials of .. ..	31
"  "  , timbers from .. ..	275
"  deposits in British Guiana .. ..	477
"  "  "  Tanganyika .. ..	237
"  distribution in Nigeria .. ..	226
"  mining in Ontario .. ..	53
"  occurrence in Nigeria .. ..	482
"  "  "  Sierra Leone .. ..	483
Gorli seed, oil from .. ..	357
<i>Gracilaria Wrightii</i> seaweed from Seychelles .. ..	297
Greenheart for paper-making .. ..	4, 6
<i>Green Manuring: Principles and Practice</i> .. ..	124
GREGORY, J. W., <i>The Elements of Economic Geology</i> .. ..	265
Ground-nuts, recent research on .. ..	199, 347, 457
<i>Guide Pratique de la Prospection des Mines et de leur Mise en Valeur</i> .. ..	129
Gum, popular .. ..	315
"  , red .. ..	316
"  , ridge .. ..	315
Gypsum, export from Cyprus .. ..	225
HAAS, P., and HILL, T. G., <i>An Introduction to the Chemistry of Plant Products. Volume I—On the Nature and Significance of the Common Organic Compounds of Plants</i> .. ..	532
<i>Handbook of Chemistry and Physics</i> .. ..	264
<i>Handbook of Ore Dressing</i> .. ..	130
HARRINGTON, G. S., the mining industry in Nova Scotia .. ..	65
HARRIS, H. (see BAMFORD, T. G.)	
HAUPT, A. W., <i>Fundamentals of Biology</i> .. ..	403
<i>Hibiscus (Les), Culture et Exploitation</i> .. ..	522
HILL, T. G. (see HAAS, P.)	
HODGMAN, C. D., and LANGE, N. A., <i>Handbook of Chemistry and Physics</i> .. ..	264
HOLT, A. H., <i>A Manual of Field Astronomy</i> .. ..	272
Honduras pine forests .. ..	495
HOWARD, A., and HOWARD, G. L. C., <i>The Development of Indian Agriculture</i> .. ..	256
<i>Human Habitat, The</i> .. ..	265
HUNTINGDON, E., <i>The Human Habitat</i> .. ..	265
Imperial Institute, cinema .. ..	305
"  "  , dioramas .. ..	302
"  "  , Public Exhibition Galleries .. ..	300
<i>Impurities in Metals: Their Influence on Structure and Properties</i> .. ..	405
India, <i>Acacia arabica</i> (Babul) pods from .. ..	36
"  , lac experiments in .. ..	97, 372, 494
"  , myrobalans in .. ..	22
"  , tanning materials of .. ..	22, 31, 34, 36, 38, 312, 314, 317-319



KIRKPATRICK, W. H. (*see* CARSLAW, R. MCG.)

Kliphout .. .. . 312

KNIBBS, N. V. S., *The Industrial Uses of Bauxite* .. .. 406

Kwabohora or Kwatendro (*Entandrophragma* sp.) timber from  
Gold Coast .. .. . 275

Lac cultivation in India .. .. . 372

„ experiments in India .. .. . 97, 494

„ industry of Cambodia .. .. . 98

LANGE, N. A. (*see* HODGMAN, C. D.)

LARSON, C. W., and others, *Dairy Cattle Feeding and Manage-  
ment* .. .. . 534

Lead deposits in Nigeria .. .. . 227

*Leather Trades' Year Book*, 1928 .. .. . 401

LECOMTE-DENIS, M., *Guide Pratique de la Prospection des Mines  
et de leur Mise en Valeur* .. .. . 129

Leeward Islands, cotton growing in Antigua and Montserrat .. 206

„ „ , onion cultivation in .. .. . 196

„ „ , papaw experiments in .. .. . 220

„ „ , sugar-cane experiments in .. .. . 193

„ „ , sweet potato cultivation in .. .. . 190

Legumes, Tanganyika, relative value as food crops .. .. 186

LEPPAN, H. D., *The Agricultural Development of Arid and Semi-  
Arid Regions, with Special Reference to South Africa* .. 398

*Licania venosa* wood for paper-making .. .. . 5

Lignite beds in Nigeria .. .. . 227

Lignites of the British Empire .. .. . 151

LILLEY, E. R., *The Geology of Petroleum and Natural Gas* .. 538

Limestone occurrence in Gold Coast .. .. . 481

„ „ „ Nyasaland .. .. . 231

Linseed, experiments in Iraq .. .. . 200

Liquorice, export from Palestine .. .. . 83

Litchis, dried, from Mauritius .. .. . 423

*Long Vegetable Fibres* .. .. . 521

Low, A. H., *Technical Methods of Ore Analysis for Chemists  
and Colleges* .. .. . 269

Lucerne, cultivation of .. .. . 356

McNAIR, J. B., *Citrus Products, Part II* .. .. . 259

Madagascar clove industry .. .. . 323

„ „ , tanning barks of .. .. . 374

Magbevi nuts from Sierra Leone .. .. . 144

Mahogany, Gaboon .. .. . 379

Maize in Kenya .. .. . 354

„ „ , influence of mosaic disease on productiveness .. 85

„ „ , recent research on .. .. . 178

*Malay Peninsula, Commercial Timber Trees of the* .. .. 262

Manganese ore, production in Cyprus .. .. . 224

Mangrove wood from Madagascar, paper-making trials with .. 493

	PAGE
Manila hemp from St. Vincent .. .. .	I
<i>Manufacture and Uses of Concrete Products and Cast Stone</i> ..	270
<i>Manure and Manuring</i> .. .. .	125
Manures, recent research on .. .. .	172, 334, 432
<i>Manuring, Principles and Practice of Green</i> .. .. .	124
Marishiballi wood for paper-making .. .. .	4, 12
Marri kino .. .. .	316
MARTINDALE, W. H., <i>The Extra Pharmacopœia of Martindale and Westcott</i> .. .. .	400
MASON, A., <i>Spraying, Dusting and Fumigating of Plants</i> ..	401
MATTHEWS, A. B., <i>Electro-Farming, or the Application of Electricity to Agriculture</i> .. .. .	402
MAUNIER, E., <i>Les Plantes à Parfums des Colonies Françaises</i> ..	526
Mauritius, coffee from .. .. .	418
"    , dried litchis from .. .. .	423
"    , hemp, investigations in the Federated Malay States ..	213
"    , soil investigations in .. .. .	331
"    , sugar-cane investigations in .. .. .	342
"    , tanning materials of .. .. .	31
"    , tobaccos from .. .. .	135
MAXWELL, F., <i>Economic Aspects of Cane Sugar Production</i> ..	121
<i>Medicine, Recent Advances in Tropical</i> .. .. .	126
<i>Metallurgist's Manual</i> .. .. .	130
Mica, production in Tanganyika .. .. .	239
MICHEL, E., <i>Les Vers à Soie Sauvages du Congo Belge</i> ..	523
MICHOTTE, F., <i>Les Hibiscus, Culture et Exploitation</i> ..	522
Millet (sorghum), recent research on .. .. .	179
Mineral resources of British Guiana .. .. .	476
"    "    " Cyprus .. .. .	223, 478
"    "    " Federated Malay States .. .. .	480
"    "    " Fiji .. .. .	226
"    "    " Gold Coast .. .. .	481
"    "    " Nigeria .. .. .	226, 482
"    "    " Nyasaland .. .. .	228
"    "    " Sierra Leone .. .. .	483
"    "    " Uganda .. .. .	485
<i>Mineralogy, Elements of Optical</i> .. .. .	131, 543
<i>Mineralogy, Soil</i> .. .. .	132
<i>Minerals, Determination of, under the Microscope</i> .. ..	543
MINIKIN, R. C. R., <i>Modern Coal-Washing Practice</i> .. ..	270
Mining and metallurgy, the Second (Triennial) Congress of ..	39
<i>Mining Engineers' Handbook</i> .. .. .	267
Mining in Nova Scotia .. .. .	65
Mining, metallurgical and power developments in the provinces of Ontario and Quebec .. .. .	42
Mining, the present status and future possibilities of the mining industry in British Columbia .. .. .	69
MİYAWAKI, A., <i>Condensed Milk: A Study of Condensed, Evaporated and Powdered Milk</i> .. .. .	401
Mohair, from Iraq .. .. .	140

	PAGE
Montan wax, extraction from brown coal .. ..	160
Montserrat, citrus in .. ..	451
"    , coffee planting in .. ..	175
"    , cotton experiments in .. ..	461
"    , tobacco in .. ..	216, 473
Moor, C. G., <i>Tin Mining</i> .. ..	405
Mora wood for paper-making .. ..	4, 9
Moraballi wood for paper-making .. ..	4, 15
Morabukea wood for paper-making .. ..	4, 14
Morocco, tanning materials of .. ..	99
MUNDEY, A. H., <i>Tin and the Tin Industry</i> .. ..	269
Myrobalans industry in India .. ..	22
NADKARNI, K. M., <i>The Indian Materia Medica</i> .. ..	262
New Zealand, fuller's earth from .. ..	148
"    "    , tobacco from .. ..	288
Nickel mines in Ontario .. ..	45
Nipa palm as a source of alcohol in Malaya .. ..	161
Nigeria, cotton experiments in .. ..	206, 462
"    , ginger growing in .. ..	455
"    , mineral resources of .. ..	226, 482
"    , moulding of cocoa beans in .. ..	174
"    , oil palm experiments in .. ..	202, 458
"    , soil investigations in .. ..	171, 435
"    , yam investigations in .. ..	190, 452
Nova Scotia, the mining industry in .. ..	65
Nyasaland, cotton experiments in .. ..	209, 462
"    , green manures for tea in .. ..	440
"    , mineral resources of .. ..	228
"    , new stem-borer of coffee .. ..	175
"    , soy bean variety trials in .. ..	204
"    , tea pests in .. ..	176
"    , tobacco experiments in .. ..	216, 473
*OAKLEY, F. I., <i>Long Vegetable Fibres</i> .. ..	521
Oats, variety tests in Iraq .. ..	179
Ocotea <i>Rodiei</i> wood for paper-making .. ..	5
Oil palm cultivation in Malaya .. ..	88, 488
"    "    in British West Africa .. ..	358
"    "    "    Federated Malay States .. ..	488
"    "    industry of Gold Coast .. ..	359
"    "    "    Sumatra .. ..	91
"    "    plantations of Sumatra and Malaya .. ..	360, 361
"    "    , recent research on .. ..	200, 458
"    (see also Palm oil)	
seeds, awarra palm fruits ( <i>Astrocaryum Jauari</i> ) .. ..	413
"    , candlenuts ( <i>Aleurites triloba</i> ) .. ..	487
"    , coconuts .. ..	196, 346, 357, 455, 488

	PAGE
Oil seeds, crabwood ( <i>Carapa guianensis</i> ) .. ..	411
" " , gorli seed ( <i>Oncoba echinata</i> ) .. ..	357
" " , ground-nuts .. ..	199, 457
" " , linseed .. ..	200
" " , oil palm .. ..	200, 358, 458, 488
" " , sesame .. ..	203
" " , soy bean .. ..	204
Oils, essential, Australian sandalwood oil .. ..	365
" " , citronella .. ..	459
" " , clove .. ..	323
" " , patchouli .. ..	204
" " , peppermint oil .. ..	364
" " , production in the United States .. ..	366
Oils, Fats and Fatty Foods: Their Practical Examination .. ..	259
Okoumé or Gaboon mahogany .. ..	379
<i>Oncoba echinata</i> seed, oil of .. ..	357
Onions, cultivation in Leeward Islands .. ..	196
Oranges, preparation and packing for transport .. ..	326
Orcharding .. ..	121
Ore Analysis for Chemists and Colleges, Technical Methods of .. ..	269
Ore Dressing, Handbook of .. ..	130
<i>Oxytenanthera abyssinica</i> in Southern Rhodesia .. ..	377
Palestine, deposits of rock phosphates in .. ..	84
" , liquorice from .. ..	83
" , silk production in .. ..	84
" , wool development in .. ..	84
Palm oil, manufacture in Sumatra .. ..	489
" , preparation in Ivory Coast .. ..	363
<i>Palmier à Huile: Mémoires et Rapports sur les Matières Grasses,</i> <i>Tome III</i> .. ..	260
Papaw, breeding experiments in the Leeward Islands .. ..	220
Paper-making materials, <i>Aspidosperma excelsum</i> wood .. ..	5
" " , Australian timbers .. ..	95
" " , <i>Dimorphandra Mora</i> wood .. ..	5
" " , <i>Eperua falcata</i> wood .. ..	5
" " , <i>Eschweilera laevifolia</i> wood .. ..	5
" " , <i>Licania venosa</i> wood .. ..	5
" " , mangrove wood .. ..	493
" " , <i>Ocotea Rodiei</i> wood .. ..	5
" " , <i>Pentaclethra filamentosa</i> wood .. ..	5
" " , <i>Pinus insignis</i> wood .. ..	491
" " , woods from British Guiana .. ..	4
Para rubber, recent research on .. ..	215, 351, 471
<i>Parfums des Colonies Françaises, Les Plantes à</i> .. ..	526
<i>Paspalum conjugatum</i> grass from British Honduras .. ..	296
Patchouli, in Seychelles .. ..	204
PEELE, R., <i>Mining Engineers' Handbook</i> .. ..	267
<i>Pentaclethra filamentosa</i> wood for paper-making .. ..	5

	PAGE
Peppermint oil in Southern Ireland and Western Australia ..	364
Peru, wool production in .. .. .	76
Petroleum in Nigeria .. .. .	228, 483
<i>Petroleum-Vademecum</i> .. .. .	539
Phosphate, deposits of, in Palestine .. .. .	84
<i>Phyllanthus Emblica</i> (aoula), use as a tanning material ..	317
<i>Piassava</i> , retting trials in Sierra Leone .. .. .	213
PIETERS, A. J., <i>Green Manuring: Principles and Practice</i> ..	124
Pine, Aleppo .. .. .	318
" , Australian .. .. .	313
" , bark .. .. .	313
" , black .. .. .	313
" , Burma hill .. .. .	318
" , Chir .. .. .	318
" , Cypress .. .. .	313
" , forests of Honduras .. .. .	495
" , white .. .. .	313
<i>Pinus halepensis</i> (Aleppo pine), use as a tanning material ..	318
" , <i>insignis</i> timber, strength of Australian grown ..	494
" , " wood, use for paper-making .. .. .	491
" , <i>Khasya</i> (Burma hill pine), use as a tanning material ..	318
" , <i>longifolia</i> (chir), use as a tanning material .. .. .	318
<i>Pistacia atlantica</i> , leaf galls for tanning in Tripoli .. ..	101
<i>Plantes (Les) à Parfums des Colonies Françaises</i> .. .. .	526
Platinum in Nigeria .. .. .	227
" , " Sierra Leone .. .. .	232
Potatoes, sweet, cultivation in the Leeward Islands .. ..	190
<i>Products of the Empire</i> .. .. .	399
<i>Properties of Silica</i> .. .. .	542
Pyrethrum, English-grown, as an insecticide .. .. .	428
Pyrites, production in Cyprus .. .. .	223, 478
 Ratsbane, toxic properties of West African .. .. .	 143
<i>Recent Advances in Tropical Medicine</i> .. .. .	126
REDMAYNE, SIR RICHARD, The lignites and brown coals of the British Empire, and the uses to which they may be put ..	151
REINTHALER, F., <i>Artificial Silk</i> .. .. .	525
REMINGTON, J. S., <i>Seed Testing</i> .. .. .	126
Research on Empire products .. .. .	78, 168, 331, 432
<i>Rhizophora mucronata</i> wood from Madagascar, paper-making trials with .. .. .	493
Rhodesia, citrus cultivation in .. .. .	86
" , Northern, tobacco production in .. .. .	97
" , Southern, bamboo ( <i>Oxytenanthera abyssinica</i> ) in ..	377
" , " , experiments with the weevil ( <i>Calandra</i> <i>orysæ</i> ) infesting maize cobs .. .. .	178
" , " , mineral resources of .. .. .	234
" , " , tobacco, sterilisation of seed beds .. .. .	218
Rice, recent research on .. .. .	180, 339, 442



RIES, H., <i>Clays: Their Occurrence, Properties and Uses</i> ..	539
ROBERTSON, H. G. ( <i>see</i> DAVIS, A.)	
ROGERS, L., <i>Recent Advances in Tropical Medicine</i> ..	126
<i>Romance of Jute</i> .. .. .	521
Rotra ( <i>Eugenia</i> spp.) bark .. .. .	375
<i>Rumex hymenosepalus</i> (canaigre) .. .. .	37
 <i>Safety in Mines Research Laboratories, Sheffield: A Description</i>	544
St. Lucia, camphor leaves and twigs from .. .. .	294
"    , limes, discoloration in .. .. .	185
"    , molasses, investigations in .. .. .	195
St. Vincent, Manila hemp from .. .. .	1
Sal .. .. .	318
Salt production in Tanganyika Territory .. .. .	240
Sandalwood, Western Australian, characters of oil .. .. .	366
"    , "    "    , regeneration of .. .. .	365
Sand-drift planting in Cyprus .. .. .	327
Sant pods ( <i>Acacia arabica</i> ) from Sudan .. .. .	35
<i>Sanialum cygnorum</i> oil .. .. .	365, 366
" <i>lanceolatum</i> oil .. .. .	366
SCHWARZ, R., <i>Petroleum-Vademecum</i> .. .. .	539
SCRIVENOR, J. B., <i>The Geology of Malayan Ore-Deposits</i> .. .. .	404
Seaweed ( <i>Gracilaria Wrightii</i> ) from Seychelles .. .. .	297
<i>Seed Production and Marketing</i> .. .. .	125
<i>Seed Testing</i> .. .. .	126
Sesame, recent research on .. .. .	82, 203
Seychelles, coconut pests in .. .. .	199
"    , fisheries and fish resources of .. .. .	87
"    , patchouli cultivation in .. .. .	204
"    , seaweed ( <i>Gracilaria Wrightii</i> ) from .. .. .	297
"    , turtle fisheries of .. .. .	104
<i>Shorea robusta</i> (sal), use as a tanning material .. .. .	318
Siam, teak industry of .. .. .	102
Sierra Leone, bananas, immunity from Panama disease .. .. .	183
"    "    , cassava experiments in .. .. .	189
"    "    , coffee from .. .. .	418
"    "    , cotton experiments in .. .. .	212
"    "    , cover crop trials in .. .. .	168
"    "    , crop rotation trials in .. .. .	168
"    "    , fruit cultivation in .. .. .	74
"    "    , ground-nut investigations in .. .. .	199
"    "    , manurial trials with coffee in .. .. .	175
"    "    "    "    "    ginger in .. .. .	455
"    "    "    "    "    limes in .. .. .	184
"    "    "    "    "    rice in .. .. .	180
"    "    , mineral resources of .. .. .	232, 483
"    "    , palm oil investigations in .. .. .	202
"    "    , piassava experiments in .. .. .	213
"    "    , soil investigations in .. .. .	171, 233, 436

	PAGE
Sierra Leone, toxic properties of ratsbane from .. ..	143
<i>Silica, The Properties of</i> .. ..	542
Silk in Cyprus .. ..	214
"  "  Iraq .. ..	214
"  "  Palestine .. ..	84
Silks, wild, of Belgian Congo .. ..	523
Silver mining in Ontario .. ..	49
<i>Silvicultural Systems</i> .. ..	527
<i>Sisal, Empire Grown</i> .. ..	426
Sisal hemp, cultivation in Ceylon .. ..	369
"  "  , cultivation in the Gold Coast .. ..	370
"  "  , industry in Kenya .. ..	372
"  "  , recent research on .. ..	214, 350, 471
SMITH, S., <i>Cellulose Lacquers</i> .. ..	526
SMITHELLS, C. J., <i>Impurities in Metals: Their Influence on Structure and Properties</i> .. ..	405
SNODGRASS, K., <i>Fats and Oils Studies of the Food Research Institute, Stanford University, California</i> .. ..	519
<i>Soil Management</i> .. ..	123
<i>Soil Mineralogy</i> .. ..	132
Soils, mechanical analysis of heavy ferruginous .. ..	166
<i>Soils, Management and Fertilization of Farm</i> .. ..	123
<i>Soils of Cuba</i> .. ..	534
Soils, recent research on .. ..	169, 233, 331, 432
SOKOL, R., <i>Geologisches Praktikum</i> .. ..	129
SOSMAN, R. B., <i>The Properties of Silica</i> .. ..	542
Soy bean, in Nyasaland, variety trials in .. ..	204
Sponge investigation in British Honduras .. ..	223
<i>Spraying, Dusting and Fumigating of Plants</i> .. ..	401
Stannite, occurrence in limestones of Federated Malay States .. ..	481
STARR, G. E. ( <i>see</i> Cox, J. F.)	
Steel, manufacture in Canada .. ..	43
STONE, A. A., <i>Farm Machinery</i> .. ..	517
<i>Structure of the Alps</i> .. ..	128
<i>Studies of Quality in Cotton</i> .. ..	520
Sudan, <i>Acacia arabica</i> (sant) pods from .. ..	35
"  , coffee from .. ..	418
<i>Sugar Beet and Beet Sugar</i> .. ..	258
Sugar beet, De Vecchi's desiccation process .. ..	86
<i>Sugar Beet in the Eastern Counties, 1927</i> .. ..	517
Sugar beet, recent research on .. ..	196, 454
"  cane, recent research on .. ..	191, 341, 454
Sumach, Cape .. ..	314
Sumatra, oil palm industry of .. ..	360, 361
SVEDBERG, T., <i>Colloid Chemistry</i> .. ..	533
Swaziland, cotton industry of .. ..	463
SWINGLE, D. B., <i>A Textbook of Systematic Botany</i> .. ..	403
TAGGART, A. F., <i>Handbook of Ore Dressing</i> .. ..	130
Tanganyika, cotton experiments in .. ..	212

	PAGE
Tanganyika, legumes, relative value as food crops .. ..	186
"    , mineral resources of .. ..	237
"    , optimum planting distance for millet in .. ..	179
"    , poisonous properties of " Kiligi " tuber ( <i>Courbonia</i> sp.) from .. ..	322
"    , tanning materials of .. ..	31
Tanning materials, <i>Acacia arabica</i> pods .. ..	35
"    "    , "    spp. .. ..	374
"    "    , <i>algarobilla</i> .. ..	33
"    "    , <i>Anaphrenium argenteum</i> (kliphout) .. ..	312
"    "    , <i>Anogeissus latifolia</i> (dhawa) .. ..	312
"    "    , <i>Callitris</i> spp. (pine barks) .. ..	313
"    "    , canaigre ( <i>Rumex hymenosepalus</i> ) .. ..	37
"    "    , <i>Carissa spinarum</i> (karunda) .. ..	314
"    "    , <i>Casuarina equisetifolia</i> (filao) .. ..	376
"    "    , <i>Colpoon compressum</i> (Cape sumach) .. ..	314
"    "    , divi-divi pods .. ..	31
"    "    , <i>Elephantorrhiza Burchellii</i> (elands boontjes) .. ..	314
"    "    , <i>Eucalyptus alba</i> (ridge or poplar gum) .. ..	315
"    "    , " <i>calophylla</i> (red-gum, marri) .. ..	316
"    "    , " <i>diversicolor</i> (karri) .. ..	317
"    "    , " <i>gomphocephala</i> (tuart) .. ..	317
"    "    , <i>Eugenia</i> spp. (rotra) .. ..	375
"    "    , Madagascar barks .. ..	374
"    "    , mangrove bark .. ..	376
"    "    , mimosa bark .. ..	374
"    "    , myrobalans .. ..	22
"    "    , of Morocco .. ..	99
"    "    , "    the British Empire .. ..	22, 311
"    "    , <i>Phyllanthus Emblica</i> (aoula) .. ..	317
"    "    , <i>Pinus halepensis</i> (Aleppo pine) .. ..	318
"    "    , " <i>Khasya</i> (Burma hill pine) .. ..	318
"    "    , " <i>longifolia</i> (chir) .. ..	318
"    "    , <i>Pistacia atlantica</i> galls .. ..	101
"    "    , <i>Quercus</i> spp. of Morocco .. ..	100
"    "    , <i>Rhus pentaphylla</i> (tizra) .. ..	99
"    "    , <i>Shorea robusta</i> (sal) .. ..	318
"    "    , <i>Tamarix articulata</i> (takaout) .. ..	99
"    "    , teri pods .. ..	34
"    "    , <i>Terminalia Arjuna</i> (kahua) .. ..	319
"    "    , " <i>Catappa</i> (badamier) .. ..	375
"    "    , wattle bark .. ..	374
Tea Manual for Beginners .. ..	120
Tea, recent research on .. ..	176, 337, 438
Teak industry of Siam .. ..	103
Teri pods, use as tanning material .. ..	34
<i>Terminalia Arjuna</i> (kahua), use as a tanning material .. ..	319
" <i>Catappa</i> bark .. ..	375
" <i>Chebula</i> .. ..	23
Terra umbra, production in Cyprus .. ..	225

	PAGE
Terre verte, production in Cyprus .. .. .	225
Tests of Small Clear Specimens .. .. .	532
Tests of Some Home-grown Timbers in their Green Condition..	531
Textbook of Systematic Botany .. .. .	403
Timber, beetles injurious to .. .. .	164
" seasoning in Australia .. .. .	496
Timbers, achin or takwadua ( <i>Blighia sapida</i> ) .. .. .	275
" , ananta or takroa ( <i>Cynometra</i> sp.) .. .. .	276
" , awieforsemnea .. .. .	275
" , defects due to insects .. .. .	380
Timbers, French Colonial .. .. .	431
Timbers from the Gold Coast .. .. .	275
" in British Guiana .. .. .	221
" " " Honduras .. .. .	222
" , kwabohora or kwatendro ( <i>Entandrophragma</i> sp.) .. .. .	275
" of Katanga .. .. .	378
" , okoumé (Gaboon mahogany) .. .. .	379
" , seasoning .. .. .	103, 380
Timber Trees of the Malay Peninsula, Commercial .. .. .	262
Timbers, Tests of Some Home-grown, in their Green Condition	531
Timbers, Uses of Home-grown .. .. .	530
Tin and the Tin Industry .. .. .	269
Tin Mining .. .. .	405
Tin mining in Tanganyika .. .. .	238
Titanium ores in Sierra Leone .. .. .	484
Tobacco, cultivation in Ceylon .. .. .	80
" from Mauritius .. .. .	135
" " New Zealand .. .. .	288
" " Uganda .. .. .	291, 426
" , manurial trials in the United Stat .. .. .	96
" , production in Northern Rhodesia .. .. .	97
" , recent research on .. .. .	216, 472
TOBLER, DR. FR., <i>Der Flachs als Faser- und Ölpflanze</i> .. .. .	120
TREASE, G. E. (see DRIVER, J. E.)	
Trinidad and Tobago: Useful and Ornamental Plants of .. .. .	258
Trinidad, banana research in .. .. .	340
" , coconut wilt diseases in .. .. .	357
" , coffee disease in .. .. .	336
" , research on sugar technology .. .. .	343
" , soil investigations in .. .. .	333
TROUP, R. S., <i>Silvicultural Systems</i> .. .. .	527
Trysil wood for paper-making .. .. .	4, 11
Tuart .. .. .	317
Tuba root, investigations in Ceylon .. .. .	78
" " , varieties of, in Federated Malay States .. .. .	222, 476
Turtle fisheries of Seychelles .. .. .	104
Uganda, cinchona bark from .. .. .	17
" , control of coffee bug in .. .. .	438

	PAGE
Uganda, cotton experiments in .. .. .	465
"  , cover crop trials in .. .. .	168
"  , ground-nut experiments in .. .. .	200
"  , mineral resources of .. .. .	240, 485
"  , rubber selection trials in .. .. .	472
"  , seeding experiments with buckwheat in .. .. .	176
"  , sesame trials in .. .. .	203
"  , shading of coffee trees in .. .. .	175
"  , tobacco experiments in .. .. .	219, 426, 475
"  , "  from .. .. .	291, 426
"  , variety trials with beans .. .. .	188
"  , "  "  " <i>Eleusine coracana</i> .. .. .	177
"  , "  "  "  maize in .. .. .	178
"  , "  "  "  mutama millet in .. .. .	179
Union of South Africa, tanning materials of .. .. .	312, 314
United States Oil Policy .. .. .	538
UNWIN, A. H., <i>Goat-Grazing and Forestry in Cyprus</i> .. .. .	402
<i>Uses of Home-grown Timbers</i> .. .. .	530
<i>Vers à Soie Sauvages du Congo Belge</i> .. .. .	523
Wallaba wood for paper-making .. .. .	4, 7
WALLACE, D. R., <i>The Romance of Jute</i> .. .. .	521
Water power resources of Canada (Niagara and the Saguenay) .. .. .	44
"  supply of Nigeria, trial wells in Sokoto Province .. .. .	483
<i>Water Supply of Towns and the Construction of Waterworks</i> .. .. .	271
Wheat cultivation in Kenya .. .. .	355
"  , variety trials in Iraq .. .. .	180
WHEELER, E., <i>The Manufacture of Artificial Silk with Special Reference to the Viscose Process</i> .. .. .	261
WILLIAMS, R. O. ( <i>see</i> FREEMAN, W. G.) .. .. .	
WINCHELL, A. N., <i>Elements of Optical Mineralogy</i> .. .. .	131, 543
<i>Wire Ropes in Mines</i> .. .. .	268
Wool, from Iraq .. .. .	140, 215
"  , importation of rams into Palestine .. .. .	84
"  , production in Peru .. .. .	76
WORTHENS, E. L., <i>Farm Soils: Their Management and Fertilization</i> .. .. .	123
Yams, recent research on .. .. .	190, 452
Yaruru wood for paper-making .. .. .	4, 9





